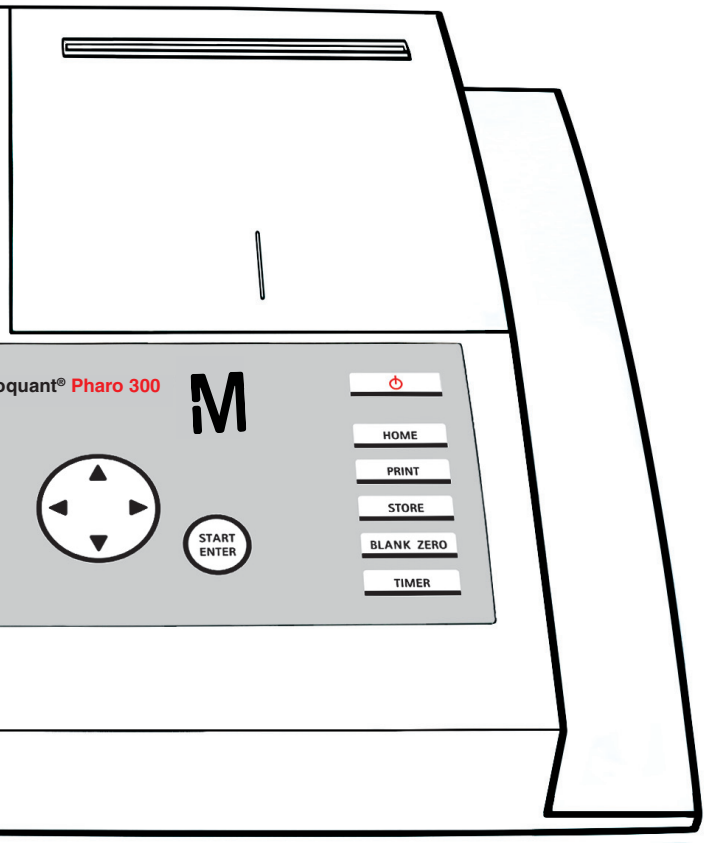
Spectroquant®

Pharo 300

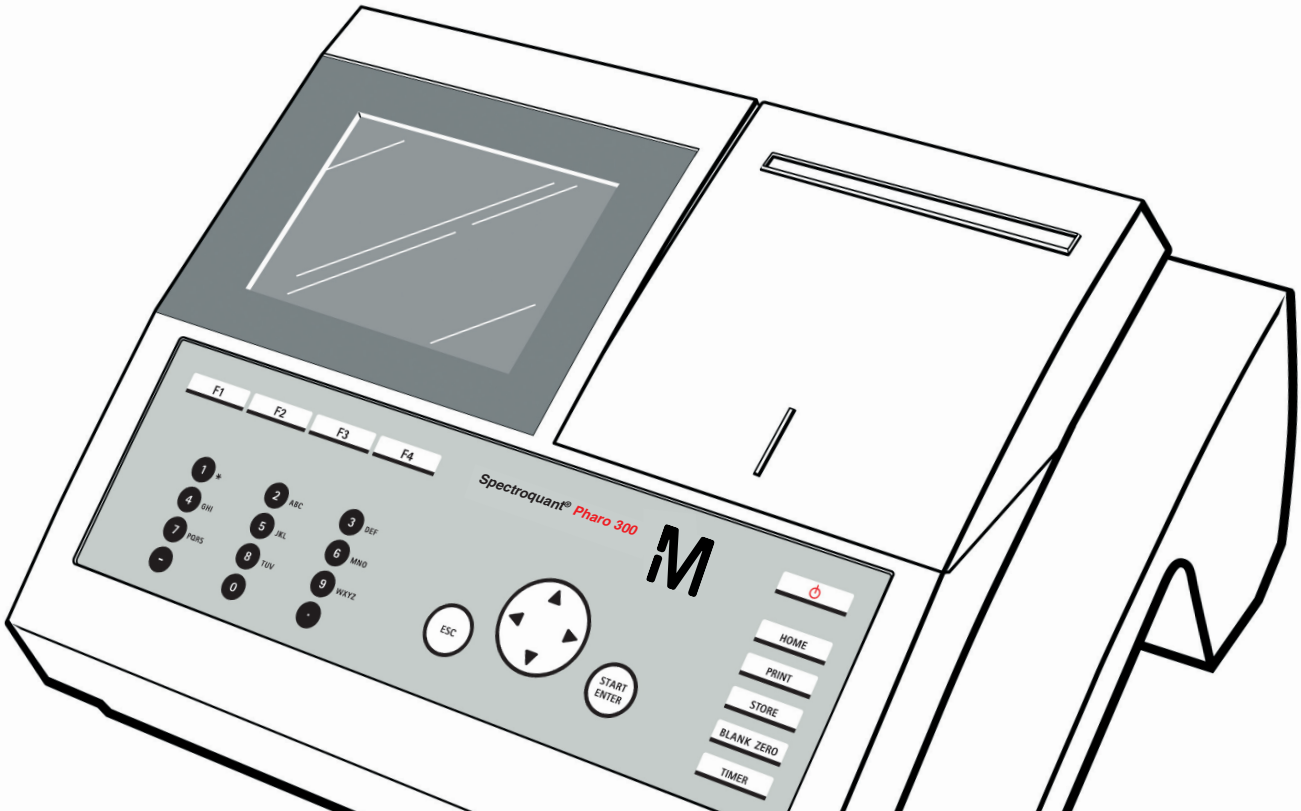


en

Operating manual

Spectroquant® UV/VIS Spectrophotometer

Pharo 300

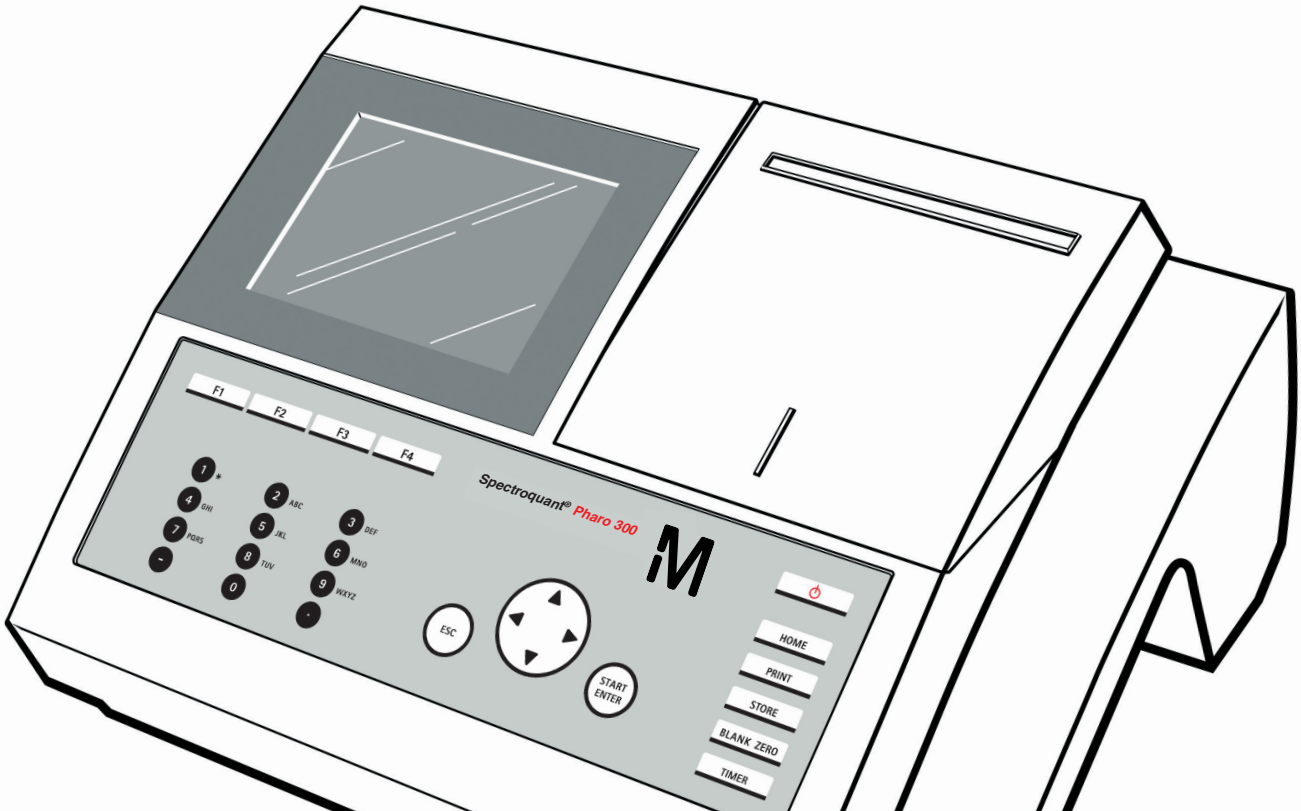


eng

Spectroquant® UV/VIS Spectrophotometer

Pharo 300

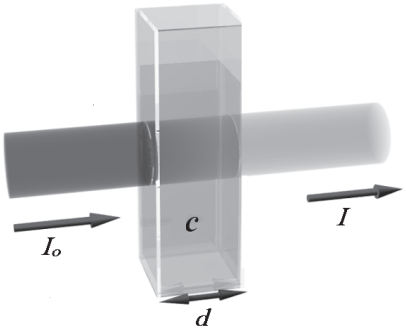
General Information



Contents

1 Photometers

1.1 Photometry



When a beam of light is transmitted through a colored 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 specific wavelengths.

Monochromators (e. g. narrow-band interference filters, lattices) are used to select the wavelength from the total spectrum of a tungsten-halogen lamp (VIS spectrum), a deuterium lamp (UV spectrum) or, respectively, a xenon lamp.

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

$$\mathbf{T = I/I_0}$$

$\mathbf{I_0}$ = 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:

$$\mathbf{A = -\log T}$$

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:

$$\mathbf{A = \varepsilon_\lambda \cdot c \cdot d}$$

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

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 for the test kits (Cell Tests **and** reagent tests) belonging to the Spectroquant® analysis system is automatically selected via the scanning of the bar code.
- All cells formats used are automatically identified and the correct measuring range is selected automatically.
- Instrument-supported AQA ensures that measurement results can be used as secure, reproducible, and recognized analytical results.
- New methods can be downloaded from the internet site www.service-test-kits.com and permanently stored in the instrument.

For technical data and instructions for use please refer to the section “Function description” or can also be found on the internet.

2 Photometric Test Kits

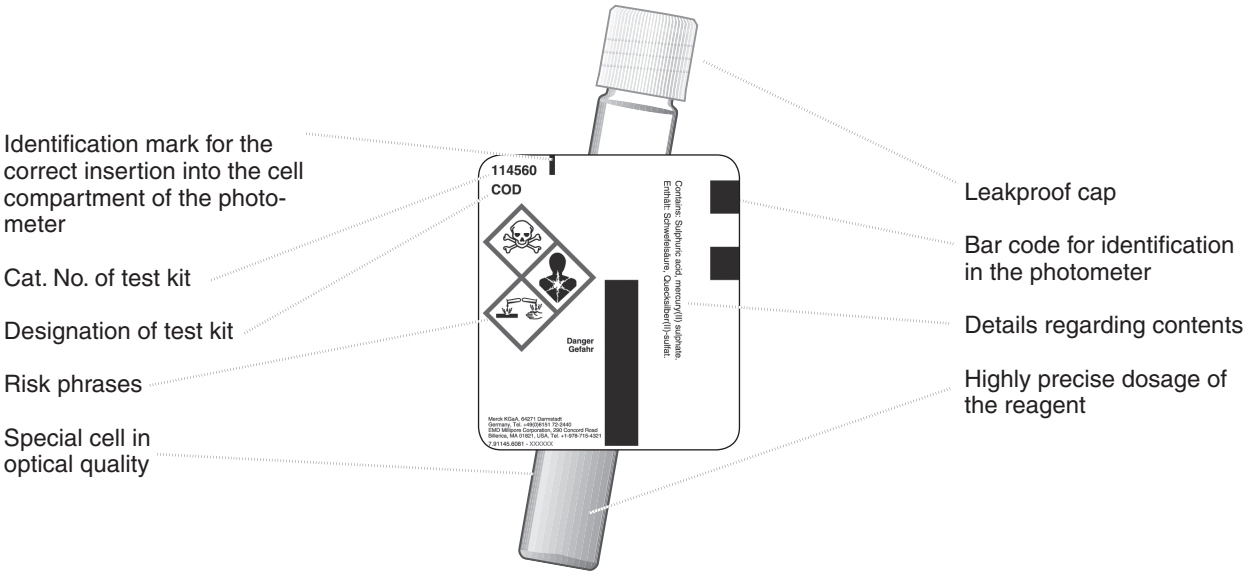
2.1 Basic Principle

By means of reagents, the component of a sample to be analyzed is converted into a colored compound in a specific reaction. The reagents or reagent mixtures contain – in addition to the reagent selective for a 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 color reactions are in most cases based on standardized analytical methods specifically optimized in terms of ease of use, a low working effort, and shorter reaction times. Furthermore, methods cited in the literature or developed by ourselves are also used. Details on the respective reference procedures are stated in the package insert or else in the parameter overview.

2 Photometric Test Kits

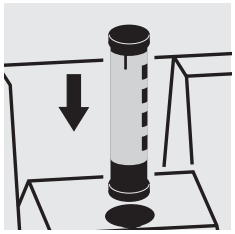
2.1.1 Spectroquant® Cell Tests



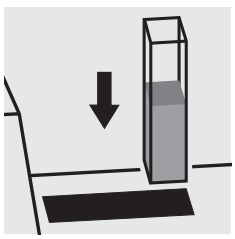
Additional reagent(s)
Certain cell tests, e. g. COD or nitrite, already contain all necessary reagents in the cells, and the sample must merely be added with a pipette. In other tests, however for reasons of chemical compatibility it is necessary to separate the test into two or three different reagent mixtures. In such cases, besides the sample a metered reagent must also be added.

2.1.2 Spectroquant® Reagent Tests

The principle behind the reagent tests is that the reagents necessary for the color reaction are combined in the form of liquid concentrates or solid-substance mixtures. A few drops of the reagent concentrate are added to the sample. This means that there is no need to dilute the sample, which in turn enhances the sensitivity of the detection. The procedure generally used in classical photometry by which the sample is made up to a defined volume in a volumetric flask is dispensed with.



The method is selected automatically by means of the scanning of the bar code by the AutoSelector.
All cells formats used are automatically identified and the correct measuring range is selected automatically.
Subsequently the result is automatically shown on the display.

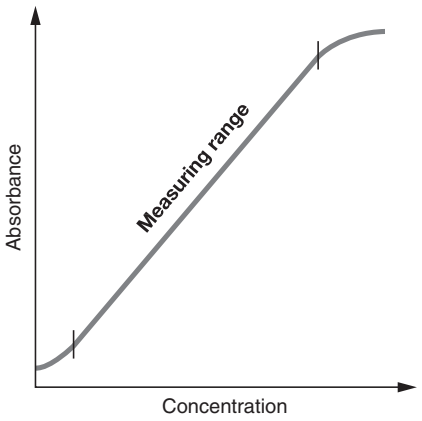


2 Photometric Test Kits

2.2 Notes for Practicle Use

2.2.1 Measuring range

The intensity of the color 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 .



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, or else is given by the method detection limit. The **method detection limit** of an analytical method is the lowest concentration of the analyte in question that can be measured quantitatively with a defined degree of probability (e. g. 99 %).
The **upper limit of the measuring range** is the point at which the linear correlation between the concentration and the absorbance ends. 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 prestored** in the photometers belonging to the Spectroquant® analysis system, which means that - due to the high batch reproducibility - it is possible to dispense with a separate measurement of the reagent blank. At the lower limit of the measuring range, the accuracy of the determination can be enhanced by performing the measurement against a separately prepared reagent blank.

In some cases the intensity of the color of the solution and thus the absorbance can drop again when **very high concentrations of the analyte** are present (see package insert).

2 Photometric Test Kits

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.

Strongly acidic (pH < 2) and strongly alkaline (pH > 12) sample 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. Any necessary correction is made by the dropwise addition of diluted acid (reduces the pH) or diluted lye (raises the pH), 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.

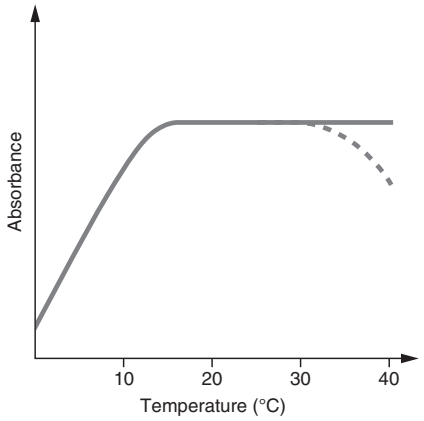
The specified pH values for the sample solution and, wherever applicable, for the measurement solution are defined in the respective package inserts and in the analysis instructions in chapter 3 of the manual.

2.2.3 Influence of Temperature

The temperature of the sample solution and the reagents may have an effect on the color reaction and thus on the measurement result. The typical temperature course is illustrated in the figure.

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 color reaction is stated in the package inserts of the respective Spectroquant® test kits.

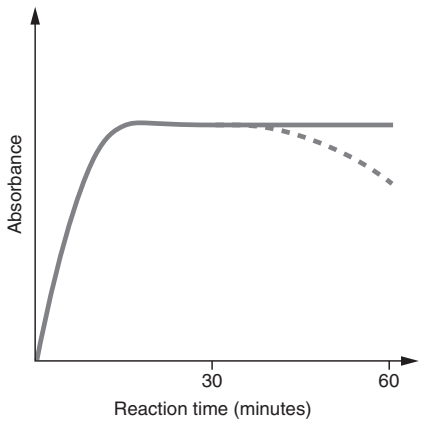
Attention! After thermic decomposition procedures, the determination of COD or total contents of nitrogen, phosphorus, or metal, a sufficient waiting time must be allowed for to permit the solution cool to room temperature.



2.2.4 Time Stability

Most of the color reactions require a certain time to reach the maximum color intensity. The solid curve in the figure at the right gives a schematic impression of a typical time course. The behavior of relatively instable color 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 color reactions.



2 Photometric Test Kits

2.2.5 Influence of Foreign Substances

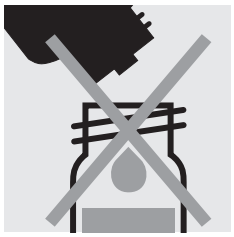
Foreign substances in the sample solution can

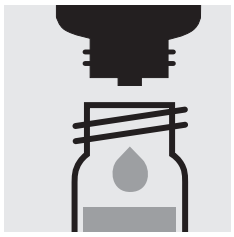
- raise the measurement value as a result of an amplification of the reaction
- lower the measurement value as a result of a prevention of the reaction.

A quantification of this 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 seawater
A tabular survey (see appendix 1) provides information on the suitability of the tests in connection with seawater and also on the tolerances for salt concentrations.

2.2.6 Dosing the Reagents

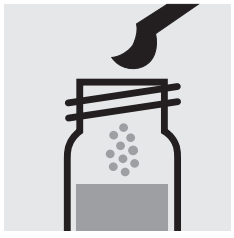




Small amounts of liquids are dosed by counting the number of drops from a leakproof bottle.

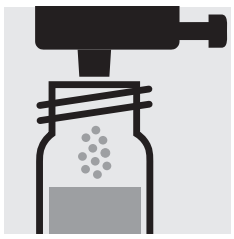
When using dropper bottles it is extremely important that the bottle be held vertically and that the drops be added slowly (approx. 1 drop per second). If this is not observed, the correct drop size and thus the correct amount of reagent are not achieved.

A positive-displacement pipette should be used for larger quantities of liquid or for the exact dosage of smaller reagent quantities. In these cases the reagent bottles are not fitted with a dropper insert.



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 is used for solid reagents or reagent mixtures that are free-flowing.
In all other cases the substances are dosed with the microspoon.

In this case it is necessary to add only level microspoonfuls. To this end the spoon must be drawn over the brim of the reagent bottle.



At the first use replace the black screw cap of the reagent bottle by the dose-metering cap.
Hold the reagent bottle vertically and, at each dosage, press the slide all the way into the dose-metering cap. Before each dosage ensure that the slide is completely retracted.

Reclose the reagent bottle with the black screw cap at the end of the measurement series, since the function of the reagent is impaired by the absorption of atmospheric moisture.

2 Photometric Test Kits

2.2.7 Shelf-life of the Reagents

The Spectroquant® test kits are in most cases stable for 3 years when stored in a cool, dry place. A few test kits have a lower shelf-life of 18 or 24 months or must else be stored in a refrigerator.
COD Cell Tests must be stored protected from light.
The expiry date of the package unit is printed on the outer label. The shelf-life may become reduced when the reagent bottles are not reclosed tightly after use or when the test kit is stored at temperatures higher than those specified.

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 case +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

3 Sample Preparation

3.2 Preliminary Tests

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. **MQuant™ 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 page 14).

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 on page 14) is entered and the measurement value is subsequently calculated correctly and immediately displayed.

3 Sample Preparation

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 higher than 100. In the event that yet higher 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 distilled 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:

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

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 for instructions).

Desired dilution	Volume of sample [ml]	Volume of distilled water [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

3.4 Filtration

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.

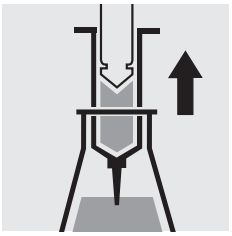
Compounds that always occur in dissolved form (for example ammonium, nitrate, nitrite, chlorine, chloride, cyanide, fluoride, orthophosphate, and sulfate) permit a previous filtration, even when the sample solution is strongly turbid.

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.

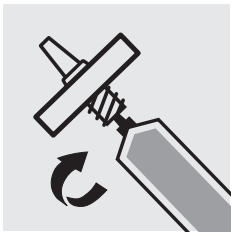
As a measure to distinguish between dissolved and undissolved water-borne substances, the water sample can be filtered through a simple paper filter. Following the recommendations stated in the reference methods, membrane filters with a pore size of 0.45 µm are required for fine filtration.

3 Sample Preparation

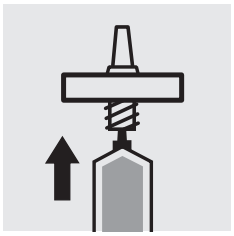
Procedure for microfiltration



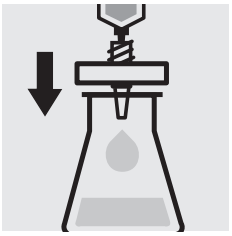
Draw out the liquid to be filtered with the syringe.



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.



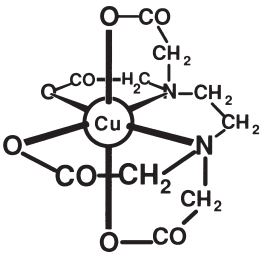
Filter the contents of the syringe into the intended glass vessel.

3.5 Homogenization

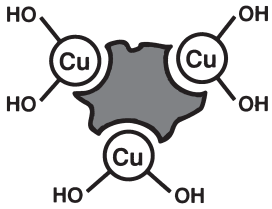
As a measure to ensure that a representative sample can be taken in the presence of suspended matter in the water sample in question, for certain parameters - e. g. COD and the total content of heavy metals - the sample must be homogenized. This must be carried out using a high-speed blender (2 minutes at 5000 – 20 000 rpm and taking the sample while stirring.

3.6 Decomposition

Ion



Complex



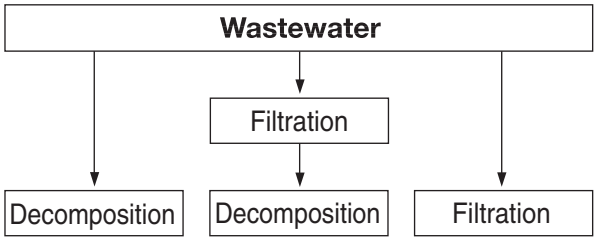
Solid substance

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.

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



Total content	Dissolved proportion	Dissolved proportion
Solid Substances		
$Cu(OH)_2$		
Complexes Cu-EDTA	**Complexes Cu-EDTA**	
Ions Cu^{2+}	**Ions Cu^{2+}**	**Ions Cu^{2+}**
Result A	Result B	Result C

Proportion:	
Ionogenic	= C
Complex	= B–C
Solid Substances	= A–B
Total content	= A

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.

The decomposition processes are carried out in the **Spectroquant® thermoreactor** (capacity: 12 or 24 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.

Determination of	Sample preparation with
Total phosphorus*	Crack Set 10 / 10C**
Total chromium* [= sum of chromate and chromium(III)]	Crack Set 10 / 10C
Total metal [= sum of free and complex-bound metal]	Crack Set 10 / 10C
Total nitrogen*	Crack Set 20

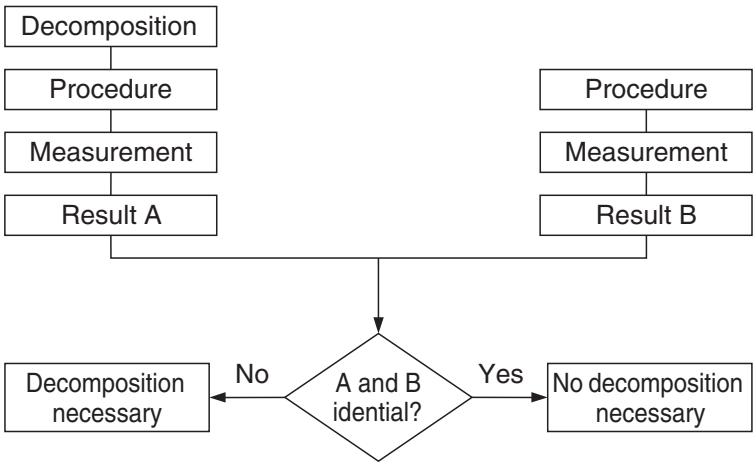
* The decomposition reagents are already contained in the packs of the respective cell tests.

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

3 Sample Preparation

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 from the **collection of applications** for real samples are available on request.

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
- 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
  a) by weighing using analytical scales (weighing accuracy ±1 mg), 1 ml of water at 20 °C = 1.000 g ±1 mg
  b) 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 in Memorandum A 704 of the German Association for the Water Sector, Wastewater, and Waste Materials (Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall e.V., DWA) and in the corresponding self-control/self-monitoring regulations of the German federal states (available in english).

Causes for errors can include:

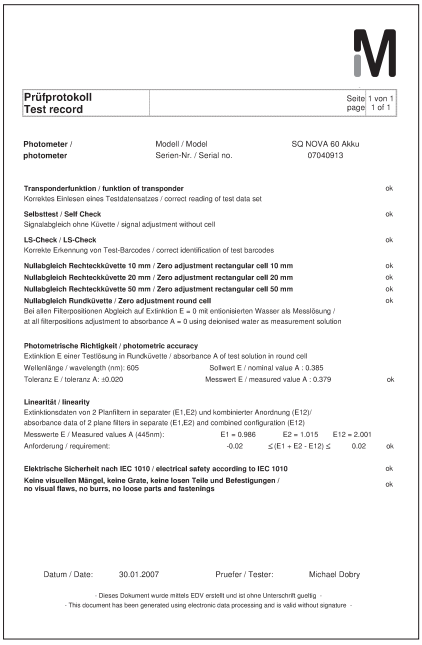
- the working materials used
- the handling
- the sample under investigation.

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

5.1 Quality Control at the Manufacturer

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.



Prüfprotokoll
Test record

Seite 1 von 1
page 1 of 1

Photometer /
photometer

Modell / Model: SQ NOVA 60 Akku
Serien-Nr. / Serial no.: 07040913

Transponderfunktion / funktion of transponder ok
Korrektes Einlesen eines Testdatensatzes / correct reading of test data set

Selbsttest / Self Check ok
Signalabgleich ohne Küvette / signal adjustment without cell

LS-Check / LS-Check ok
Korrekte Erkennung von Test-Barcodes / correct identification of test barcodes

Nullabgleich Rechteckküvette 10 mm / Zero adjustment rectangular cell 10 mm ok
Nullabgleich Rechteckküvette 20 mm / Zero adjustment rectangular cell 20 mm ok
Nullabgleich Rechteckküvette 50 mm / Zero adjustment rectangular cell 50 mm ok
Nullabgleich Rundküvette / Zero adjustment round cell ok
Bei allen Filterpositionen Abgleich auf Extinktion E = 0 mit entionisiertem Wasser als Messlösung /
at all filterpositions adjustment to absorbance A = 0 using deionized water as measurement solution

Photometrische Richtigkeit / photometric accuracy
Extinktion E einer Testlösung in Rundküvette / absorbance A of test solution in round cell
Wellenlänge / wavelength (nm): 605 — Sollwert E / nominal value A : 0.385
Toleranz E / toleranz A: ±0.020 — Messwert E / measured value A : 0.379 ok

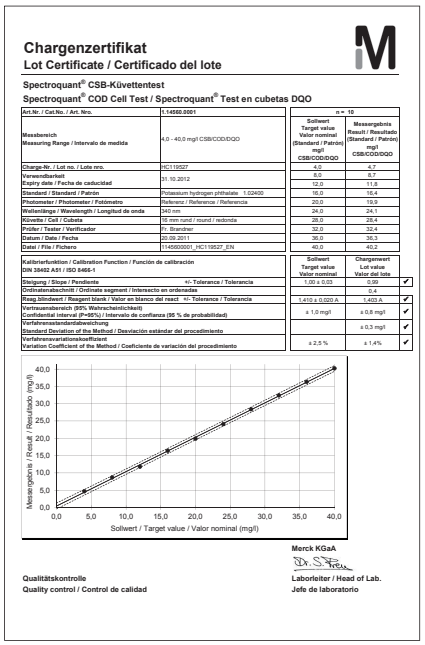
Linearität / linearity
Extinktionsdaten von 2 Planfiltern in separater (E1,E2) und kombinierter Anordnung (E12)/
absorbance data of 2 plane filters in separate (E1,E2) and combined configuration (E12)
Messwerte E / Measured values A (445nm): E1 = 0.986 E2 = 1.015 E12 = 2.001
Anforderung / requirement: -0.02 ≤(E1 + E2 - E12) ≤ 0.02 ok

Elektrische Sicherheit nach IEC 1010 / electrical safety according to IEC 1010 ok
Keine visuellen Mängel, keine Grate, keine losen Teile und Befestigungen /
no visual flaws, no burrs, no loose parts and fastenings ok

Datum / Date: 30.01.2007 Pruefer / Tester: Michael Dobry

- Dieses Dokument wurde mittels EDV erstellt und ist ohne Unterschrift gueltig. -
- This document has been generated using electronic data processing and is valid without signature -

5 Analytical Quality Assurance (AQA)



Chargenzertifikat
Lot Certificate / Certificado del lote

Spectroquant® CSB-Küvettentest
Spectroquant® COD Cell Test / Spectroquant® Test en cubetas DQO

		n = 10	
Art.Nr. / Cat.No. / Art. Nro.	**1.14560.0001**		
Messbereich **Measuring Range / Intervalo de medida**	4.0 - 40.0 mg/l CSB/COD/DQO	**Sollwert** **Target value** **Valor nominal** **(Standard / Patrón)** **mg/l** **CSB/COD/DQO**	**Messergebnis** **Result / Resultado** **(Standard / Patrón)** **mg/l** **CSB/COD/DQO**
Charge-Nr. / Lot no. / Lote nro.	HC119527	4,0	4,7
Verwendbarkeit **Expiry date / Fecha de caducidad**	31.10.2012	8,0	8,7
		12,0	11,8
Standard / Standard / Patrón	Potassium hydrogen phthalate 1.02400	16,0	16,4
Photometer / Photometer / Fotómetro	Referenz / Reference / Referencia	20,0	19,9
Wellenlänge / Wavelength / Longitud de onda	340 nm	24,0	24,1
Küvette / Cell / Cubeta	16 mm rund / round / redonda	28,0	28,4
Prüfer / Tester / Verificador	Fr. Brandner	32,0	32,4
Datum / Date / Fecha	20.09.2011	36,0	36,3
Datei / File / Fichero	1145600001_HC119527_EN	40,0	40,2

Kalibrierfunktion / Calibration Function / Función de calibración **DIN 38402 A51 / ISO 8466-1**		**Sollwert** **Target value** **Valor nominal**	**Chargenwert** **Lot value** **Valor del lote**	
Steigung / Slope / Pendiente	**+/- Toleranz / Tolerancia**	1,00 ± 0,03	0,99	✔
Ordinatenabschnitt / Ordinate segment / Intersecto en ordenadas			0,4	
Reag.blindwert / Reagent blank / Valor en blanco del react	**+/- Toleranz / Tolerancia**	1,410 ± 0,020 A	1,403 A	✔
Vertrauensbereich (95% Wahrscheinlichkeit) **Confidential interval (P=95%) / Intervalo de confianza (95 % de probabilidad)**		≤ 1,0 mg/l	≤ 0,8 mg/l	✔
Verfahrensstandardabweichung **Standard Deviation of the Method / Desviación estándar del procedimiento**			≤ 0,3 mg/l	✔
Verfahrensvariationskoeffizient **Variation Coefficient of the Method / Coeficiente de variación del procedimiento**		≤ 2,5 %	≤ 1,4%	✔

Merck KGaA

Qualitätskontrolle
Quality control / Control de calidad

Laborleiter / Head of Lab.
Jefe de laboratorio

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

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.

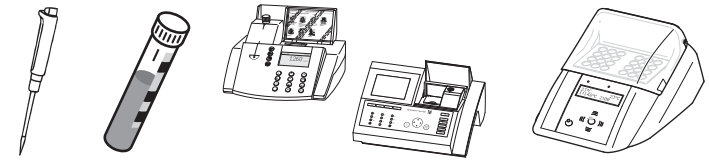
Coefficient of variation for the procedure:
Measurement for the dispersion of the measurement values over the entire measuring range, expressed in %. The smaller the standard deviation/ coefficient of variation for the procedure, the more pronounced the linearity of the calibration curve.

5.2 Quality Control for the User

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:

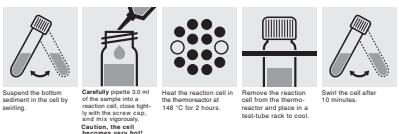
Checking the working equipment



Pipette Test kit Photometer Thermoreactor

= Test for the overall system

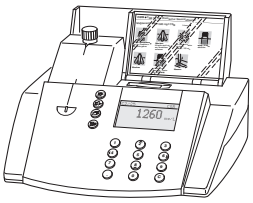
Checking the handling operations

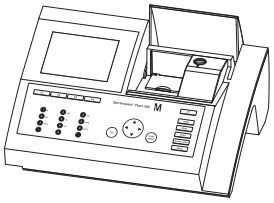


Influence of the sample **Test for recovery**

5 Analytical Quality Assurance (AQA)

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.

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** with 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 certificate stating the absorbance values is enclosed with the package unit. 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 on the display and can be entered into the corresponding control chart.

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 Spectroquant® PhotoCheck. The PhotoCheck hence offering the possibility to check the instrument. All of the corresponding documentation, required by these certification guidelines, is done by the photometer automatically.

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.

Standard solutions for photometric applications (CRM) are ready-to-use standard solutions that in terms of the analyte concentration are finely adjusted to the individual test kits. The standard solution is used in the same way as a sample. A double determination is recommended as a measure to diagnose any random errors.

In addition to the CombiCheck and the standard solutions for photometric applications, it is also possible to use **CertiPUR® 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 presented in Appendix 2 provides an over-view of the available CombiCheck and ready-to-use standard solutions.

5 Analytical Quality Assurance (AQA)

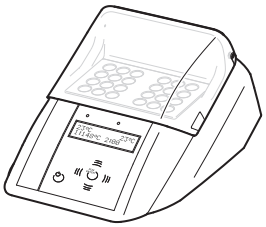
Due to limited shelf-life characteristics, there are no CombiCheck or ready-to-use standard solutions for certain parameters. Appendix 3 is a compilation of **standard working procedures** necessary to make your own solutions of a defined concentration. This allows the control of parameters where there are no simple to prepare solutions available.

If the test for the overall system shows that all requirements are fulfilled, the individual results are flagged as AQA2. 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 color-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



This is checked by means of the thermosensor. The thermoreactor is preheated as described in the Instructions for use. When the control lamp goes out, the temperature is measured in any one of the bores of the thermoreactor. The following desired temperatures must be achieved:

Block temperature 100 °C = desired temperature 100 ±3 °C
Block temperature 120 °C = desired temperature 120 ±3 °C
Block temperature 148 °C = desired temperature 148 ±3 °C

The even distribution of the temperature over all bores can also be documented using the thermosensor.

5 Analytical Quality Assurance (AQA)

5.2.5 Testing for Handling Errors

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 of the sample and measurement solution correct?
- Was the reaction time adhered to?
- Does the sample and reagent temperature lie within the correct range?
- Is the cell clean and free from scratches?
- Has the expiry date for the test kit been exceeded?

5.3 Determination of Sample Influences (matrix effects)

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.

5 Analytical Quality Assurance (AQA)

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.

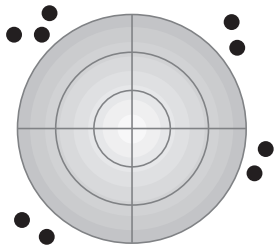
Systematic errors are present when all the results of an analysis deviate from the true value with the same algebraic sign. Examples here include: a wrong sample volume, a wrong pH, a wrong reaction time, a sample-matrix influence, etc. Systematic errors thus affect the **accuracy** of the method of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

Accuracy = Deviation of the measured concentration from the true concentration

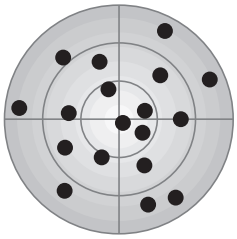
Random errors manifest themselves in the form of a wide range of deviation of the results of a given sample. These can be kept to a minimum by ensuring good operating techniques and multiple determination with calculation of the mean values. Random errors make the result of the analysis unreliable; they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

Precision = Dispersion of the results among each other

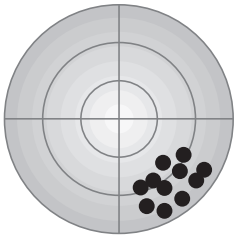
The following diagram illustrates the aspects of accuracy and precision:



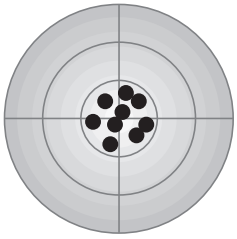
Accuracy: poor
Precision: poor
Major errors have been made!



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!



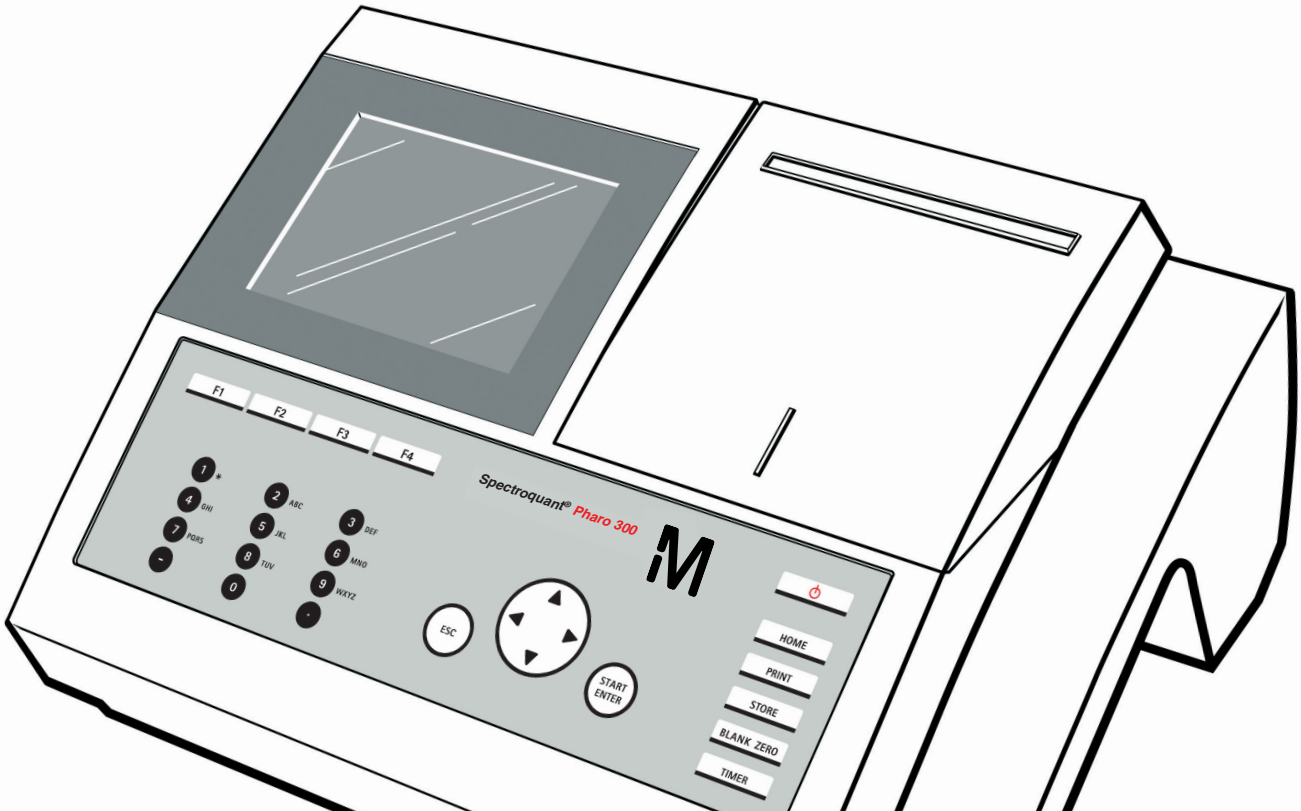
Accuracy: good
Precision: good
The ideal objective!

eng

Spectroquant® UV/VIS Spectrophotometer

Pharo 300

Description of Function



Accuracy when going to press

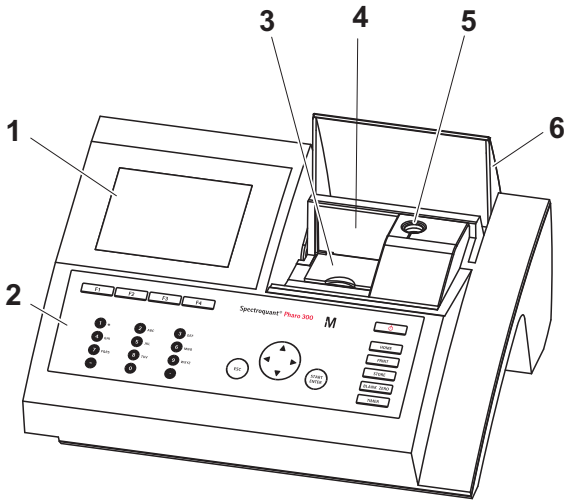
The use of advanced technology and the high quality standard of our instruments are the result of continuous development. This may result in differences between this operating manual and your instrument. Also,
we cannot guarantee that there are absolutely no errors in this manual. Therefore, we are sure you will understand that we cannot accept any legal claims resulting from the data, figures or descriptions.

Spectroquant® Pharo 300 - Contents

1 Overview

1.1 Overview of the instrument

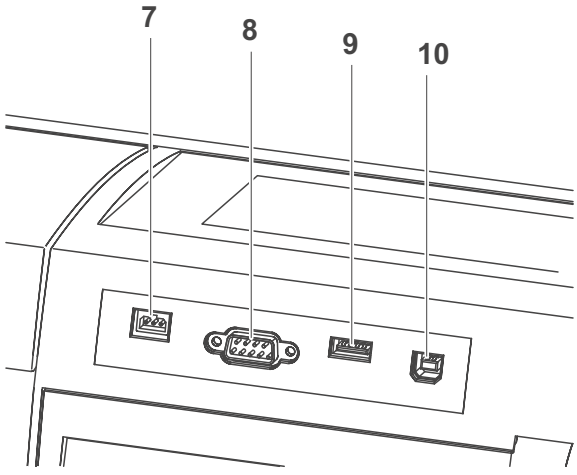
Front of the instrument



1 *Display*
2 *Keypad*
3 *Shaft for rectangular cells*
4 *Turn-up lid*
5 *Shaft for round cells*
6 *Cell shaft cover*

Fig. 1-1 Front of the instrument with operating elements

Socket field on the rear panel



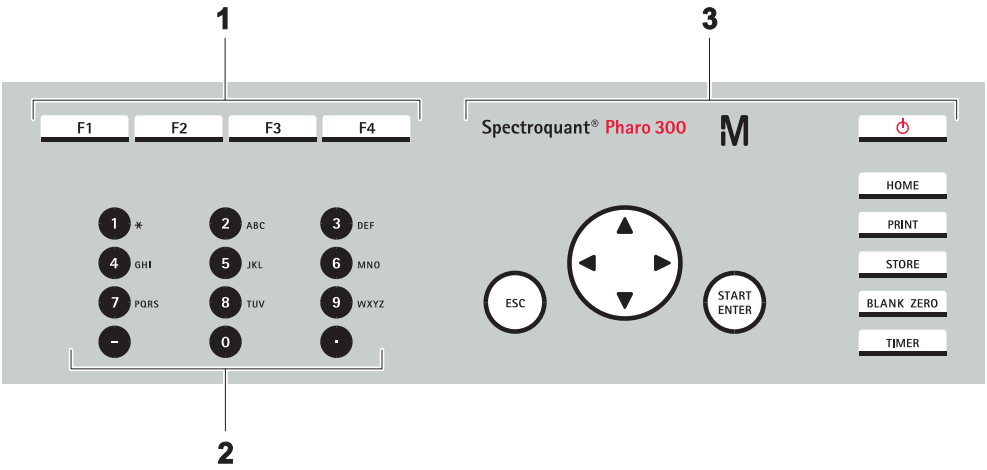
7 *Connection for power pack*
8 *RS232 connection*
9 *USB-A connection*
10 *USB-B connection*

Fig. 1-2 Rear panel with socket field

Note
All connections comply with SELV.

1.2 Keypad

Overview



1 Function keys F1 to F4 (function menu-depending)
2 Alphanumeric keypad
3 Keys with dedicated function

Fig. 1-3 Keypad

Key functions

The keys on the right side of the keypad have the following functions:

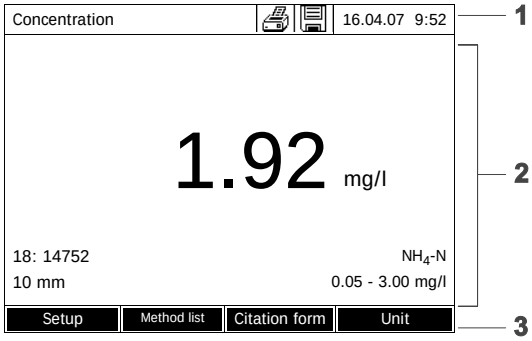
Key	Designation	Functions
⏻	**<ON/OFF>**	– Switches on and off the photometer
HOME	**<HOME>**	– Switches to the main menu from any operating situation. Actions that are not completed are canceled.
PRINT	**<PRINT>**	– Outputs the displayed measured value to an interface if the *Printer* symbol is displayed in the status line.
STORE	**<STORE>**	– Saves a displayed measured value or spectrum if the *Save* symbol is displayed in the status line.
BLANK ZERO	**<BLANK ZERO>**	– Starts one of the following measurements, depending on the operating situation: - Zero adjustment - Blank value measurement - Baseline measurement

Key	Designation	Functions
	**<TIMER>**	– Opens the menu, *Timer*.
	**<ESC>**	– Cancels the running action. Entries that have not yet been accepted are discarded. – Switches to the next higher menu level.
	**<START ENTER>**	– Starts an action (e.g. measurement) – Opens a selected menu – Confirms a selection or entry
 (Arrow keys)	**<▲>**or **<▼>**	– Moves the selection in menus and lists one position up or down
	<◀>	– Deletes the character left of the cursor during character entries – Moves the cursor to the left in a spectrum or kinetic diagram
	<▶>	– Moves the cursor to the right in a spectrum or kinetic diagram

Function keys The function keys F1 to F4 have different functions depending on the operating situation. The current functions are displayed in the function key menu at the bottom edge of the display (see section 4.2.1).

1.3 Display

Display elements



1 Status line (current state, date and time)
2 Display range for menus and measurement results
3 Function keys menu

Fig. 1-4 Display

Symbols in the status line

Symbol	Designation	Function
	*Save*	The **<STORE>** key is active. You can store the displayed data with **<STORE>** (see section 4.11).
	*Printer*	The **<PRINT>** key is active. You can output to an interface the displayed data with **<PRINT>** (see section 4.14).
	Progress bar	During the warm-up time (15 minutes) a progress bar appears on the display. The reproducibility of measured values is limited during the warm-up time (see section 4.14).

2 Safety instructions

This operating manual contains basic instructions that you must follow during the commissioning, operation and maintenance of the photometer. Consequently, all responsible personnel must read this operating manual carefully before working with the meter. Keep this operating manual in the vicinity of the meter.

General safety instructions

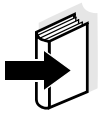
Safety instructions in this operating manual are indicated by the warning symbol (triangle) in the left column. The signal word (such as "CAUTION") indicates the danger level:

WARNING
indicates instructions that must be followed precisely in order to prevent serious dangers to personnel.

CAUTION
indicates instructions that must be followed precisely in order to avoid slight injuries to personnel or damage to the instrument or the environment.

Other labels

Note
indicates notes that draw your attention to special features.



Note
indicates cross-references to other documents.

2.1 Target group and user qualification

Carrying out photometric determinations with the aid of test sets frequently requires the handling of hazardous substances.

We assume that the operating personnel know how to handle hazardous substances due to their professional training and experience. The operating personnel must particularly be able to understand and correctly implement the safety labels and safety instructions on the packages and inserts of the test sets.

2.2 Authorized use

The Photometer was developed for use in the laboratory for water analysis. Follow the technical specifications of the cells in chapter 7 TECHNICAL DATA. Any other use is considered to be **unauthorized**.

2.3 General safety instructions

The photometer is built and inspected according to the relevant guidelines and norms for electronic instruments (see chapter 7 TECHNICAL DATA). It left the factory in a safe and secure technical condition.

Note
The opening of the photometer or adjustment and repair work must only be performed by specialist personnel authorized by the manufacturer. Noncompliance invalidates any claim with regard to the warranty.

Function and operational safety

The smooth functioning and operational safety of the photometer can only be guaranteed if the generally applicable safety measures and the specific safety instructions in this operating manual are followed during operation.

The smooth functioning and operational safety of the photometer can only be guaranteed under the environmental conditions that are specified in chapter 7 TECHNICAL DATA.

If the photometer was transported from a cold environment to a warm environment, the formation of condensate can lead to the faulty functioning of the meter. In this event, wait until the temperature of the meter reaches room temperature before putting the meter back into operation.

Safe operation

If safe operation is no longer possible, the photometer must be taken out of operation and secured against inadvertent operation.

Safe operation is no longer possible if the photometer:

- has been damaged in transport
- has been stored under adverse conditions for a lengthy period of time
- is visibly damaged
- no longer operates as described in this manual.

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

2.4 Handling of hazardous substances

When developing test sets, Merck carefully sees that the tests can be carried out as safely as possible. Some hazards by dangerous substances, however, cannot always be avoided.

WARNING
Improper handling of certain reagents can cause damage to your health.
In any case follow the safety labels on the packing and the safety instructions of the package insert. Protective measures specified there have to be followed exactly.

Safety datasheets

The safety datasheets of the chemicals comprise all instructions on safe handling, occurring hazards, preventive actions and actions to take in hazardous situations. Follow these instructions in order to work safely.

3 Commissioning

3.1 Scope of delivery

- Spectrophotometer Spectroquant® Pharo 300
- Power pack connection cable
- Buffer batteries 4 x AA alkaline manganese (Mignon)
- Zero cell (16 mm, round)
- Short instructions
- CD-ROM with
  - Detailed operating manual
  - Analysis instructions
  - SpectralTransfer software
  - Language updates to install additional character sets (see section 4.20.3)

Packing This photometer is sent out in a protective transport packing.

CAUTION
Keep the original packing including the inner packing to protect the instrument against hard shocks if it has to be transported.
Note that damage caused by improper transport voids all warranty claims.

3.2 General notes on handling

The Spectroquant® Pharo 300 photometer is an optical precision meter. Therefore, it should always be handled with care, especially in mobile use. Always protect the meter from conditions that could damage the mechanical, optical and electronic components. Heed the following points especially:

- The temperature and humidity during operation and storage must be within the limits specified in chapter 7 TECHNICAL DATA.
- The following influences always have to be avoided with the meter:
  - Extreme dust, moisture and wetness
  - Exposure to intensive light and heat
  - Fumes that are corrosive or contain high concentrations of solvents.
- For measuring, the meter must be placed on a flat surface.
- Spilled liquid or other material should be removed immediately (see section 5.2 CLEANING).
- If a cell has broken in the cell shaft, the cell shaft should be cleaned immediately (see section 6.1 ACTIONS IN THE CASE OF A BROKEN CELL).
- The cell shaft should always be closed when the photometer is not used.
- During transport of the photometer, the cell shaft has to be empty.
- For mobile use we recommend the suitable transport case (see section 8.1 ACCESSORIES).

3.3 Initial commissioning

Perform the following activities:

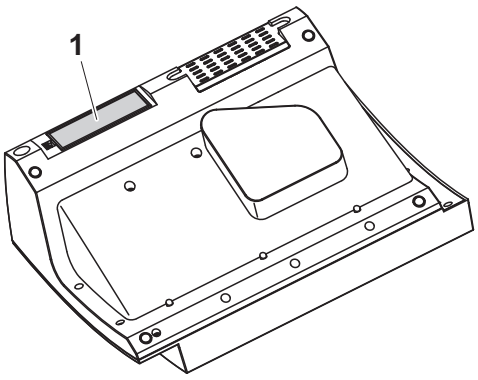
- Insert the buffer batteries (see section 3.3.1)
- Connect the power supply (see section 3.3.2)
- Switch on the photometer (see section 3.3.3)
- Set the language (see section 3.3.4)
- Set the date and time (see section 3.3.5)
- Carry out a zero adjustment (see section 4.4)

Note
When you set the language, date and time according to the mentioned sections of this operating manual you will quickly become familiar with the simple operation of the Spectroquant® Pharo 300. More detailed instructions on operation are given in section 4.2 GENERAL OPERATING PRINCIPLES.

3.3.1 Inserting the buffer batteries

The buffer batteries supply the integrated clock while the photometer is switched off. Four alkaline manganese batteries (type AA or Mignon) separately included in the scope of delivery are used as the buffer batteries.

Insert the batteries as follows:



1 Turn the photometer upside down and place it on a soft surface.

2 Open the lid of the battery compartment (1).

3 Insert the four batteries in the battery compartment. Make sure that the poles of the batteries are in the correct position.
The ± signs on the batteries must correspond to the ± signs in the battery compartment.

4 Close the lid of the battery compartment.

Battery service life The power consumption of the clock is very low. The lifetime of high quality batteries is at least 5 years.

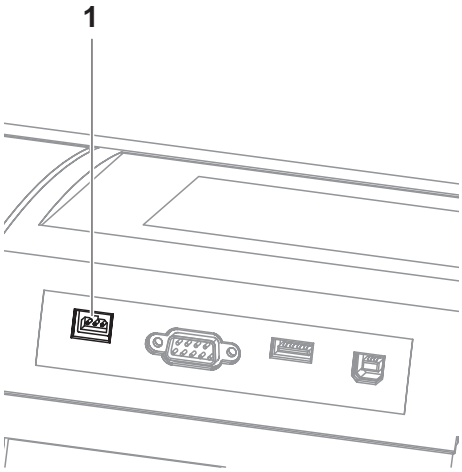
3.3.2 Connecting the power supply

The power is supplied via the enclosed plug-in power pack. The power pack supplies the photometer with low voltage (12 VDC).

CAUTION

The line voltage of the usage location must fulfill the specifications stated on the power pack (the specifications are also given in chapter 7 TECHNICAL DATA). Always use the supplied 12 V original power pack only. The power pack is not suitable for operation with older photometers (ser.no. prior to 1319xxxx).

Connecting the plug-in power pack



1 Connect the miniplug of the power pack to the socket (1) of the photometer.

2 Connect the power pack to an easily accessible power socket.

The display illumination switches itself on and then off again.

Operation with a mobile 12 V power source

You can also operate the Spectroquant® Pharo 300 on the move and independent of the local power supply.

To do so, a 12 V power supply such as a commercial 12 V portable power source or a 12 V car battery and the 12 V-Adapter available as an accessory is required (see section 8.1).

More detailed information on operation is available:

- in section 3.4.6 and
- in the operating manual of the 12 V-Adapter .

3.3.3 Switching on the photometer for the first time

During the initial commissioning, the photometer automatically guides you through the setting of the meter language, date and time after switching on (see following sections).

1 Press **<ON/OFF>**.

The photometer is switched on.

The display switches to the setting of the language (see section 3.3.4).

After the setting of the language the photometer carries out the self-test.

When the initial commissioning is completed, the photometer displays the *Home* menu each time after it is switched on and after the self-test (see section 4.1).

3.3.4 Setting the language

During the initial commissioning the photometer automatically guides you to the setting of the meter language after switching on.

1 Select a language with **<▲><▼>**.

2 Confirm the selected language with **<START ENTER>**.

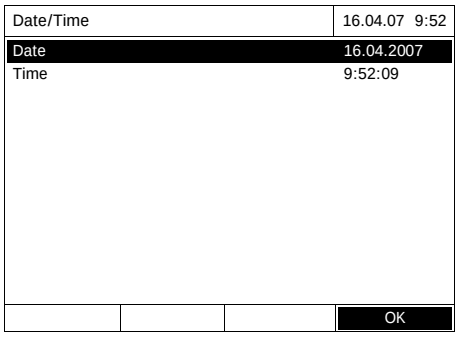
The language has been set. The currently selected language is marked by a check.

The display switches to the setting of the *Date* and *Time* (see section 3.3.5).

After the initial commissioning, you can change the language in the *General setup* / *Language* menu at any time (see section 4.2.4).

3.3.5 Setting the date and time

During the initial commissioning, the instrument automatically guides you to the setting of the time and date after the setting of the language.

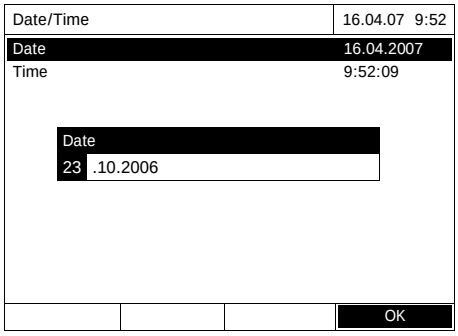


The *Date/Time* menu is open.

Using **<▲><▼>**, select a menu item and
confirm or open it with
<START ENTER>.

1 Select and confirm *Date*.

The input field for the current date pops up.

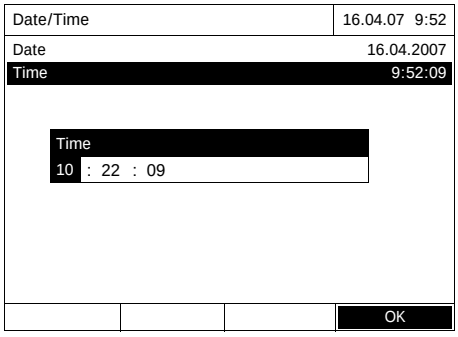


2 Enter the current date with **<0...9>** and confirm.

The input field closes.
The date is accepted.

3 Select and confirm *Time*.

The input field for the current time pops up.



4 Enter the current time with **<0...9>** and confirm.

The input field closes.
The time is accepted.

After the initial commissioning, you can change the date and time in the *General setup* / *Date/Time* menu at any time (see section 4.2.4).

3.4 Connecting optional accessories

3.4.1 Communication interfaces

Connections

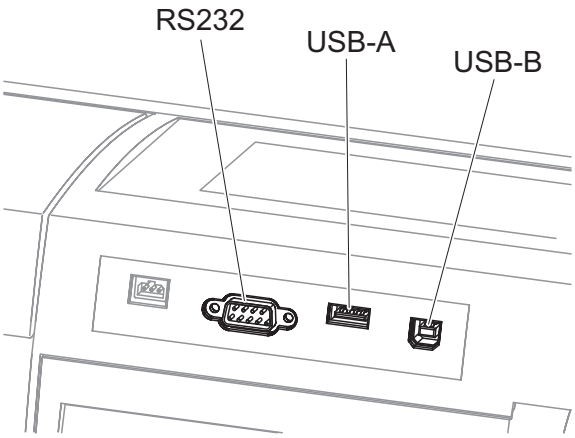


figure 3-1 Communication interfaces on the rear panel

You can connect the following accessories to the photometer:

- PC (see section 3.4.2)
- Printer (see section 3.4.2)
- USB storage media (see section 3.4.3)
- USB-PC keyboard (see section 3.4.4)
- Barcode reader (see section 3.4.5)
- 12 V-Adapter (see section 3.4.6)

Note
If you want to connect several USB devices such as a USB-PC keyboard and a USB memory device to the meter, you can increase the number of USB-A sockets by a commercially available USB-2 hub with separate power supply.

3.4.2 PC/printer

PC and printer can be connected to the photometer as follows:

Interface	PC	Printer	Functions
RS232	✓	✓	The data is sent to the interface with **<PRINT>**. ● If a printer is connected, the data is printed out. ● If a PC is connected, the data can be received with a terminal program (see section 4.14).
USB-A		✓	The data is printed out with **<PRINT>**.
USB-B	✓	-	Enables the direct connection of photometer and PC. With this you can transmit measurement data to the PC (see section 4.12 and section 4.14) or update the photometer software (see section 4.20.1). The direct connection with the PC is established with the aid of the "SpectralTransfer" program. The program is provided on the supplied CD-ROM. More instructions on how to establish the connection are given in the operating manual of the "SpectralTransfer" program (see CD-ROM).

Note
Suitable are all printers that can interpret the PCL-3 printer control language.

Operation at RS232

Connect the RS232 interface to the devices as follows:

- PC: with a commercially available zero modem cable
- Printer: with a commercially available RS232 printer cable

The cables are available in specialized computer shops.

Set up the following interface data at the PC/printer:

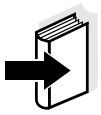
Baud rate	Selectable from 1200, 2400, 4800, 9600, 19200 The baud rate must agree with the baud rate set on the PC/printer.
Flow control ("handshake")	none
Parity	none
Data bits	8
Stop bits	1

3.4.3 USB memory device

Using a USB memory device (such as a USB flash drive), you can

- update the meter software and method data (section 4.20)
- transmit data to the USB memory device (section 4.11 and section 4.12).

USB memory devices are connected to the USB-A interface.



Note
Please follow the instructions on using USB memory devices (see section 4.11.2).

3.4.4 PC keyboard

With the PC keyboard it is possible to enter letters, e.g. to assign names for identification (ID).

In addition, the following keys of the PC keyboard are assigned with the following functions of the photometer:

PC keyboard	Photometer
Enter	**<START ENTER>**
Esc	**<ESC>**
F1 to F4	Function keys **<F1>** to **<F4>**

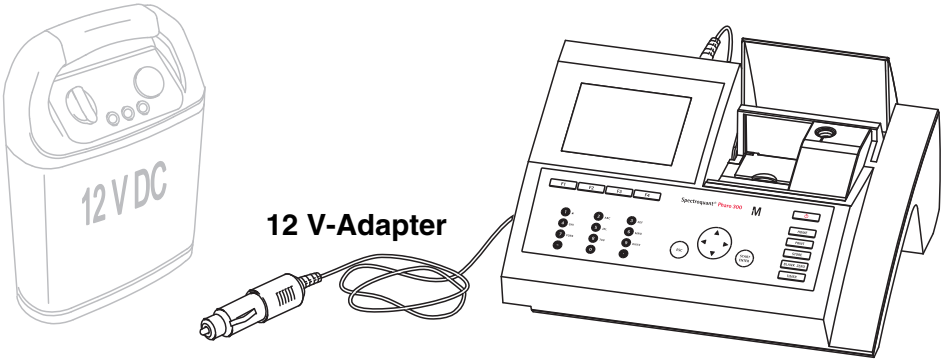
The USB-PC keyboard is connected to the USB-A interface.

3.4.5 Barcode reader

The barcode reader enables the simplified entering of alphanumerical character strings and can be used in all operating situations that require the entry of text or numerals. The barcode reader is connected to the USB-A interface.

3.4.6 12 V-Adapter

With the 12 V-Adapter you can operate the Spectroquant® Pharo 300 spectrophotometer on the move and independent of the local power supply.
To do so, a 12 V power supply such as a commercial 12 V portable power source or a 12 V car battery is required.



12 V power supply unit (e.g. portable power source or car battery)

Spectroquant® Pharo 300

Safety instructions

For operation with an external battery, follow the safety instructions of the battery.
Make sure the power source is suitable for operation of the spectrophotometer (see technical data of the power source and technical data of the spectrophotometer).

Operating time with battery

The maximum operating time depends on various factors:

- Battery (e.g. nominal capacity, condition, age)
- Operating mode of the spectrophotometer (e.g. frequency of measurements)
- Photometer (instrument type)

Example

Operating time with a type 12 V / 19 Ah battery in optimum condition: approx. 16h

Note
The spectrophotometer consumes electricity even while it is in standby mode.
We recommend to disconnect the 12 V-Adapter if you do not use the photometer during battery operation.

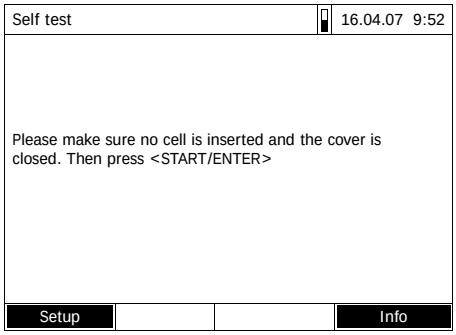
Technical data 12 V-Adapter

Cable length	2 m
max. voltage	12 V
max. current	8 A

4 Operation

4.1 Switching on or off the photometer

Switching on



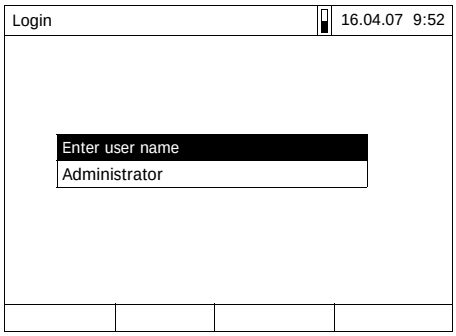
1 Switch the photometer on with **<ON/OFF>**.

The display shows

– the *Self test* dialog (if the user management is not active).

or

– the *Login* dialog (if the user management is active).



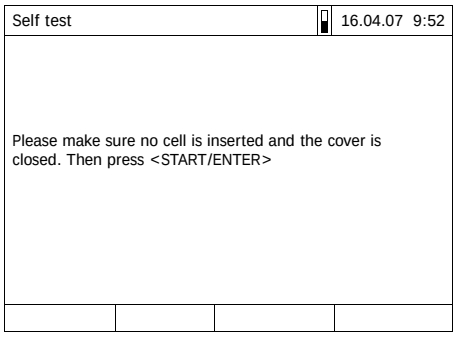
With activated user management:

2 Login

Enter user name and password or register as a guest (see section 4.16.4).

Then the photometer displays the *Self test* dialog.

Starting the *Self test*



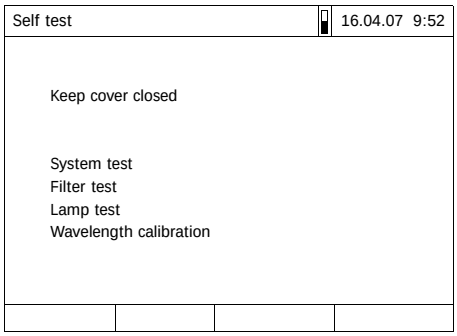
3 Remove all cells and close the cell shaft cover.

4 Start the self-test with **<START ENTER>**.

The photometer carries out the self-test.

Self test

During the self-test, all cells must be removed and the cell shaft cover closed.



The self-test includes:

– the test of the memory, processor,
internal interfaces,
filter and lamp
– a calibration for each wavelength

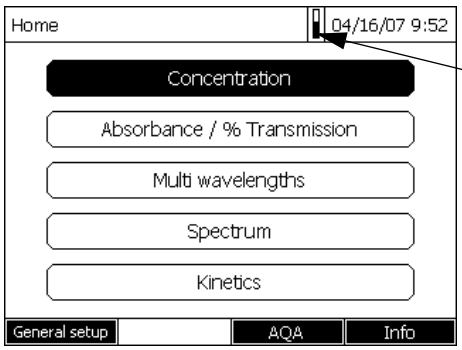
After the self-test is completed, the main menu is displayed.

Note
The result of the self-test can be viewed and printed with the *[Info]* function key (see section 4.18).

Warm-up time

After being switched on the photometer requires a warm-up time of 15 minutes. Reproducibility of measurement data is restricted during the warm-up time.
Therefore, do not measure during the warm-up time.

During the warm-up time, a progress bar appears on the display next to the date. The progress bar disappears as soon as the warm-up time is over.



AutoCheck

With the AutoCheck function the photometer checks and calibrates the optical measuring unit. The AutoCheck is automatically carried out if measurement settings were changed since the last measurement, e.g.:

- if a different wavelength was selected or
- if a different method was selected.

If necessary, the photometer asks you to remove the cell from the cell shaft.

With unchanged measurement settings, the AutoCheck is carried out in the background at regular intervals of 5 minutes. The AutoCheck can only be carried out in the background if the cell shaft is empty. If a cell is in the cell shaft the AutoCheck is carried out only after the cell was removed.

Note
Remove the cell from the cell shaft after every measurement. Thus the photometer can carry out the regular AutoCheck.
Cells must be completely removed from the cell shaft.
Cells that are removed only half disturb the AutoCheck measurement and, as a consequence, falsify measured values until the next AutoCheck is carried out.
Plastic cells that are not recognized by the automatic cell recognition also disturb the AutoCheck.

Note
During a running kinetic measurement the photometer cannot carry out any AutoCheck. That is why in this case a warm-up time of two hours is required. After this time the signal is stable enough so that the measurement accuracy is secured over a longer period of time.

Automatic wavelength calibration

With the automatic wavelength calibration function the photometer checks and calibrates the accuracy of the wavelengths created by the monochromator.

The wavelength calibration of the photometer is regularly carried out after switching on (with the self-test) and is automatically repeated during operation after 15, 30, 60, 120 and 240 minutes.

A note is displayed while the photometer is carrying out the automatic wavelength calibration. The automatic wavelength calibration only starts when the cell shaft is empty.
If a cell is in the cell shaft the wavelength calibration is carried out only after the cell was removed.

Display illumination

The photometer automatically switches off the display illumination if no key has been pressed for 5 minutes. The illumination is switched on again with the next keystroke. The function of the key becomes active only with the following keystroke.

Switching off

To switch the photometer off, keep the **<ON/OFF>** key depressed until the photometer is switched off.

4.2 General operating principles

4.2.1 Navigating with function keys and menus

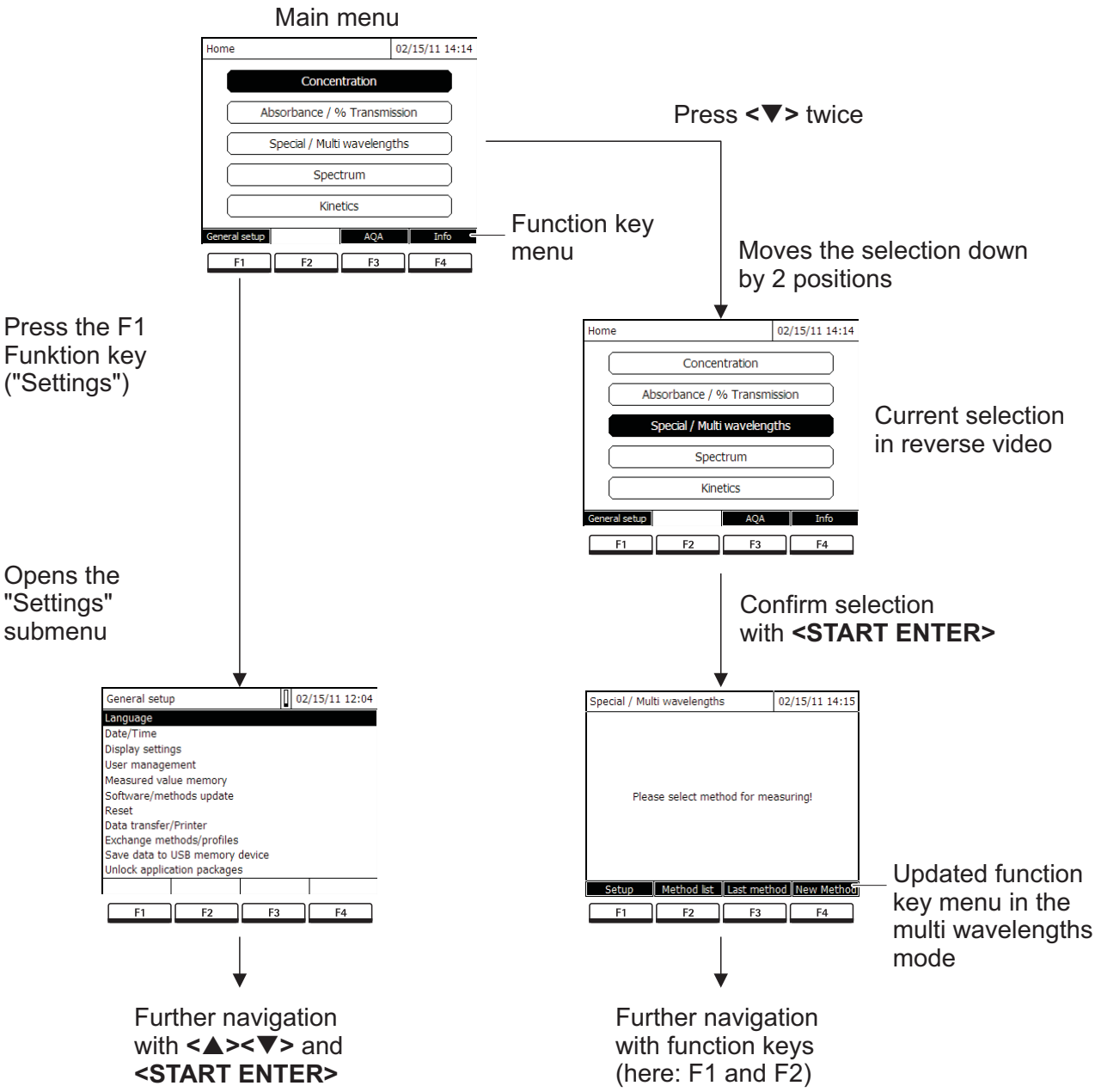


figure 4-1 Example of navigation with function keys (left) and "classical" menu navigation (right)

Use of the function keys

The function keys F1 to F4 are below the display. Their functions change depending on the operating situation and mode. The current functions are displayed in the function key menu at the bottom edge of the display.

Apart from navigation, the function keys are also used for other operations:

- Opening a selection list or input field
- Executing a command (directly or with intermediate query)
- Switch over between two display options, such as absorbance ↔ transmission

Navigation with arrow keys (<▲><▼>) and <START ENTER>

These operating elements are used to select an item from a menu or list. The current selection is displayed in reverse video. Pressing of **<START ENTER>** confirms the selection.

Apart from navigation, the **<START ENTER>** key is also used for other operations:

- Opening a selection list or input field
- Confirming a selection
- Confirming entries of text and numerals
- Executing a command (directly or with intermediate query)
- Activating an item in a selection list (✓ = active)

4.2.2 Display of navigation paths in short form

In this operating manual, the introductory navigation steps leading to individual menus or dialogs are clearly shown in a gray box. The box indicates a section of the menu tree.

Starting point of the description is always the main menu, which can be reached with the **<HOME>** key from any operating situation. From there navigation takes place downward.

Operating example: Navigation to the setting menu for the language

The following example shows the elements of the menu tree with the relevant operating steps:

<HOME>
[General setup]
├ *Language*

Bold letters and angle brackets indicate a key on the photometer (except function keys).

→ Press the "Home" key.
The main menu is called up.

Square brackets indicate a function key F1 to F4. The text between the brackets corresponds to the assignment according to the function key menu on the bottom edge of the display.

→ Press the function key with the assignment "Settings"

Text without brackets stands for a menu item indicated on the display (list item).

→ Select the menu item with the arrow keys **<▲><▼>**. The current selection is displayed in reverse video.
→ Then press **<START ENTER>**.

Further navigation options:

- The **<ESC>** key moves you one level up in the menu tree.
- The **<HOME>** key directly calls up the main menu.

Note
If you are "lost" in a menu, press **<HOME>** and restart navigating from the main menu.

Note
The complete menu tree is given in the appendix of this operating manual.

4.2.3 Entry of numerals, letters and characters

Numerals, letters, punctuation marks and special characters are entered with the alphanumeric keypad of the meter or using an external keyboard. Entries are required in operating situations such as the following:

- Entering the date and time
- Entering an ID e.g. when storing measurement data
- Selecting a method with the *[Search]* function
- Programming user-defined methods
- Entering user name and password
- Administrating users

Character set

The following characters are available:

- Numerals 0 ... 9
- Letters A ... Z and a ... z
- Punctuation marks. -
- Special characters ° / + ² ³ # %

Operating principle

Entering characters is always possible if there is an input field on the display.

The numerals and characters (expect for the small letters) assigned to the keys of the alphanumeric keypad are printed on the keys. Example: With the **<7/PQRS>** key you can enter the following characters: 7, P, Q, R, S, p, q, r, s.

Select the required character by pressing the key several times (similar to a mobile phone). When pressing a key that is assigned to several characters once, the respective numeral appears first. To enter a numeral, one key-pressing is always sufficient.

When pressing the key for the first time a line pops up that displays all characters possible with this key. The currently selected character is highlighted.

A character is taken over in the input field if

- the character is highlighted for more than one second,
- the character is confirmed with **<START ENTER>**,
- another alphanumeric key is pressed.

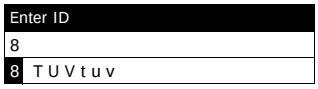
Note
During mere number entries (such as entering a wavelength), the keys of the alphanumeric keypad are assigned to the respective numeral only. Each key-pressing directly enters the numeral (like a pocket calculator).

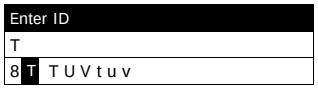
Special characters

Special characters are entered with the **<1/*>** key.

Operating example: Entering the ID

The *Enter ID* input field appears if you press the **<STORE>** key while the storing symbol is visible. In the following example a measurement dataset with the ID "Test" is stored.





1. Press **<8/TUV>** several times until "T" appears in the input line.

   Below the input field, a selection line pops up with all characters that are available for this key, e.g. *8 T U V t u v*.
   The currently selected character is highlighted.

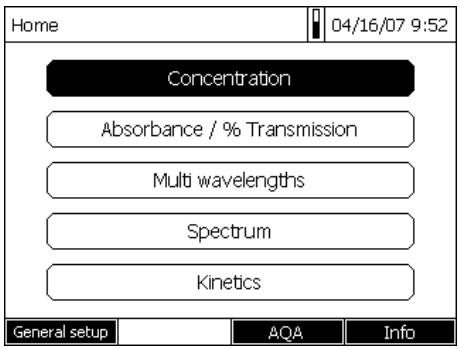
   After approx. one second the character is taken over and the selection line closed.

2. Complete the ID with **<A...9>** and confirm.

Correcting incorrect entries

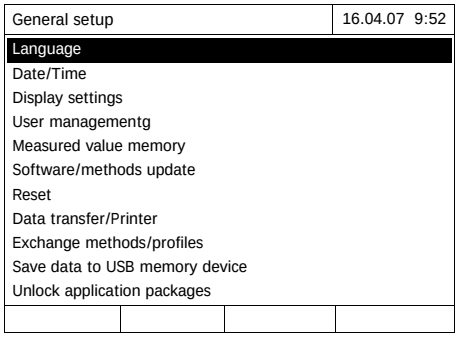
Using **<◀>**, erase all characters until you have reached the incorrect digit and repeat the entry from there.

4.2.4 Detailed operating example: Changing the language



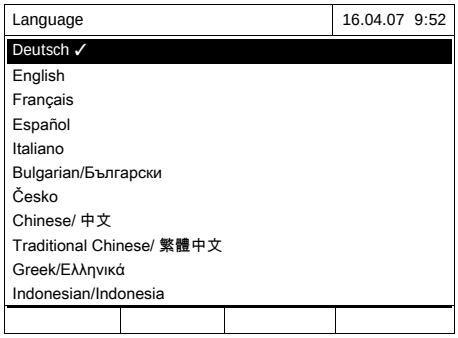
1 Call up the main menu with the **<HOME>** key.

2 Open the *General setup* menu with the F1 function key *[Setup]*.



3 Using **<▲><▼>**, select the *Language* menu item and open with **<START ENTER>**.

The *Language* menu shows a list with the available languages. The currently active language is marked by a check.



4 Select the required language from the list with **<▲><▼>** and confirm with **<START ENTER>**.

The selected language is taken over immediately. The photometer moves up one menu level.

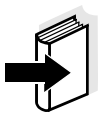
4.3 Photometer settings and system administration

The general photometer settings are done in the **<HOME>** -> *General setup* menu. The general photometer settings comprise:

- Language (see section 4.3.1)
- Date/time (see section 4.3.2 and section 4.2.4)
- Display characteristics (see section 4.3.3)
- User management (see section 4.16)
- Administration of the measurement data memory (see section 4.11)
- Software and method update (see section 4.20)
- Reset of the settings to default values (see section 4.17)
- Settings for data transmission (see section 4.14.2)

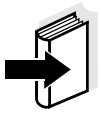
4.3.1 Language

The complete list of the available instrument languages is given in the *Language* chapter 7 TECHNICAL DATA menu of the photometer.



Note
If you want to set some special languages on your photometer (e.g. Chinese or Thai), a character set extension is required to display the characters (see section 4.20.3).

For more languages please contact your Merck supplier.



Note
How to set the language is described in detail in the operating example in section 4.2.4.

4.3.2 Date/Time

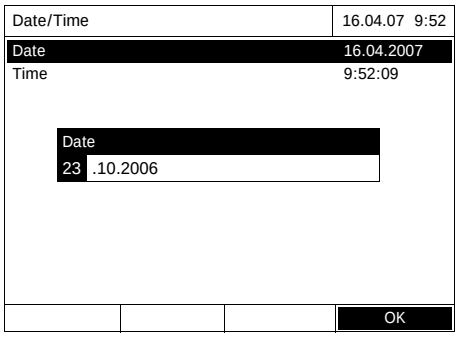
The date format is set automatically with the language setting.
According to the locally usual version, the date format is displayed in the order, Day.Month.Year (*DD.MM.YY*) or Month/Day/Year (*MM/DD/YY* or *MM.DD.YY*).

<HOME>
[General setup]
Date/Time

The *Date/Time* menu is open.

1 Select and confirm *Date*.

The input field for the current date pops up.

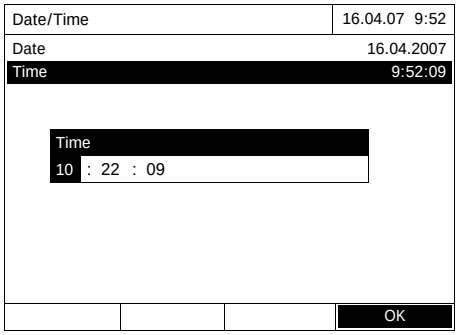


2 Enter the current date with **<0...9>** and confirm.

The input field closes.
The date is accepted.

3 Select and confirm *Time*.

The input field for the current time pops up.



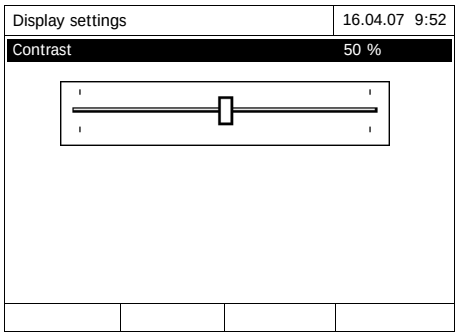
4 Enter the current time with **<0...9>** and confirm.

The input field closes.
The time is accepted.

4.3.3 Display settings

Here you can adjust the display contrast to the lighting conditions.

<HOME>
[General setup]
Display settings



1 Select and confirm C*ontrast*.

A slide control for the display contrast appears.

2 Using **<◀><▶>**, set the display contrast and confirm.

4.4 Zero adjustment

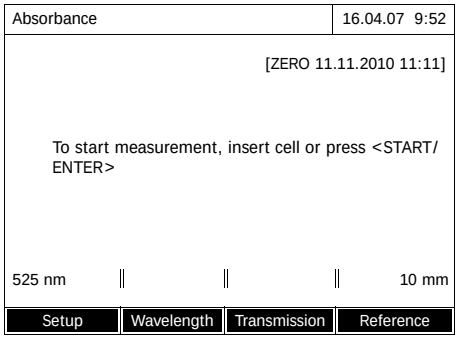
A valid zero adjustment is required for the calculation of measured values in the modes, *Concentration*, *Absorbance / % Transmission*, *Special / Multi wavelengths* and *Kinetics*. With a zero adjustment, the absorbance of a cell filled with distilled water ("zero cell") is measured and stored.

Factory zero adjustment for concentration measurements

For all measurements with Spectroquant® test sets (*Concentration* mode), a factory zero adjustment is available in the delivery condition. We recommend replacing it with a zero adjustment of your own.

Zero adjustment for absorbance measurements

In the *Absorbance* mode, the zero adjustment has to be carried out separately for each cell type and each used wavelength. If a zero adjustment exists already for the inserted cell type at the selected wavelength, the date and time of the last zero adjustment are displayed in the top right area of the display.



If no zero adjustment is available, the photometer will prompt you to carry out a zero adjustment.

Note
The cells must be absolutely clean and free of scratches.
Always use a cell of the same type for zero adjustment and measurement of the sample.

Notes on zero adjustment

Zero adjustment with round cells:

- Only use clean, scratch-free round cells with distilled water. The minimum filling level is 20 mm. A ready zero cell is included in the scope of delivery of the photometer and PhotoCheck (see chapter 8 ACCESSORIES AND OPTIONS).
- A ready zero cell can, in principle, be used any number of times. We recommend, however, to regularly check the zero cell for visible contamination and scratches and refill or exchange it if necessary (at least every 24 months).

Zero adjustment with rectangular cells:

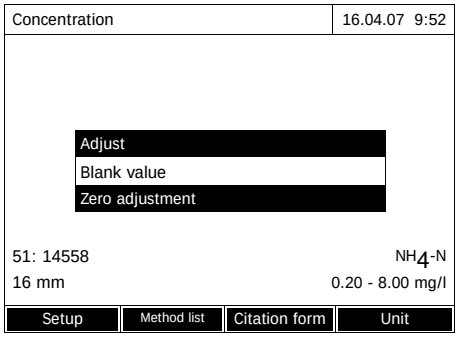
- For rectangular cells, the zero adjustment must be carried out with the same cell type (manufacturer and cell material [e.g. optical glass, quartz glass, plastic]) that is used for measurement. This is important because cells of different manufacturers have a different absorption behavior. When changing the cell type repeat the zero adjustment with the new type.
- Prior to zero adjustment, clean the rectangular cell and fill it with distilled water. The minimum filling level is 20 mm.
- Rectangular cells always have to be inserted in the cell shaft with the same orientation for measurement and zero adjustment (e.g. cell printing on the left side).

Note
Ordering information is given in chapter 8 ACCESSORIES AND OPTIONS. The cells listed in the chapter 8 ACCESSORIES AND OPTIONS are especially adapted to the Merck Spectroquant® test set program. General requirements of the cells are given in chapter 7 TECHNICAL DATA. Note that the spectral transparency of the cell must be suitable for the intended application (example, quartz cell for UV range).

Carrying out a zero adjustment

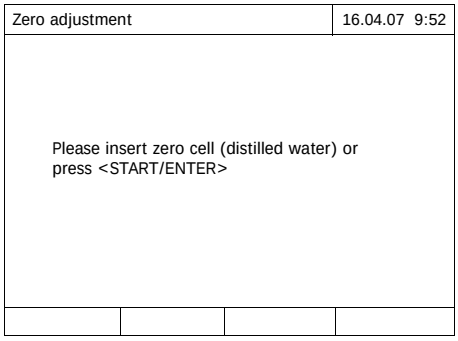
The zero adjustment takes place similarly in the *Concentration*, *Absorbance / % Transmission*, *Special / Multi wavelengths* and *Kinetics* modes.

1 In the respective mode, press the **<BLANK ZERO>** key.

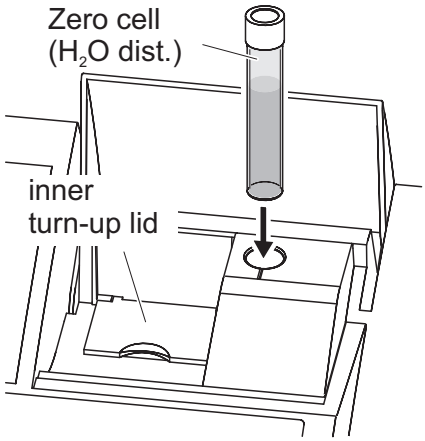


2 In *Concentration* mode only:

Select and confirm *Zero adjustment*.



The zero adjustment window pops up.



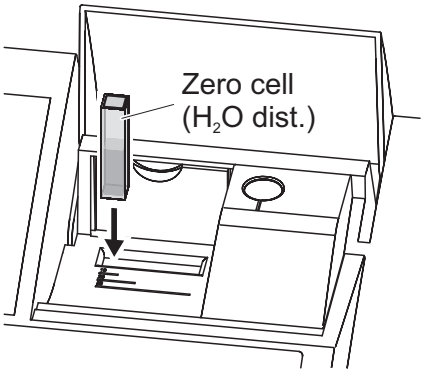
3 Close the inner turn-up lid.

4 Depending on the cell type, insert the zero cell as follows:

<u>Round cell:</u>

Insert the round cell in the round cell shaft so it touches the bottom.

If the inner turn-up lid is opened too wide, a message prompts you to close the inner turn-up lid.

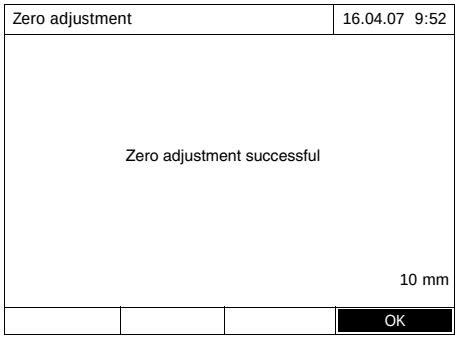


Rectangular cell:

Open the inner turn-up lid.

Insert the rectangular cell vertically so it touches the bottom and left edge of the cell shaft. The opaque sides of the rectangular cell must point to the front and back.

The photometer has an external light recognition. If there is too much external light, a message prompts you to close the cell shaft cover.



The photometer automatically starts the zero adjustment and subsequently stores the value.

5 After a successful zero adjustment switch to measurement with *[*OK*]*.

Validity of the zero adjustment

The data of the zero adjustment is stored in the photometer separately for each cell type. As long as the data is valid, it is automatically used again after a temporary change to a different cell type. The validity depends on the respective mode:

Mode	Validity of the zero adjustment
Concentration (permanently programmed methods)	● Till the next zero adjustment
Absorbance / % Transmission	● Till the next zero adjustment with the same wavelength *
Concentration (user-defined methods) and *Special / Multi wavelengths*	● Till the next zero adjustment for the same method *
Kinetics	● Till another kinetic profile is loaded ● Till the *Kinetics* mode is exited or the photometer is switched off

* After the wavelength or method respectively was temporarily exited the photometer displays that a zero adjustment is available and the time it was carried out. You can then decide whether to use this zero adjustment or carry out a new zero adjustment.

When to repeat the zero adjustment?

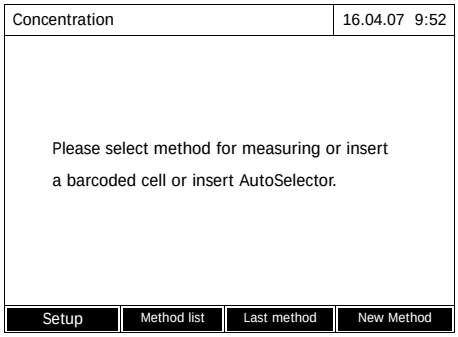
We recommend to repeat the zero adjustment in the following cases:

- If the photometer was subject to mechanical stress such as strong shock or transport
- If the ambient temperature changed by more than 5 °C since the last zero adjustment
- At least once per week
- If a new cell type (different manufacturer, different glass type is used)
- Basically each time you want to measure with the highest possible accuracy.

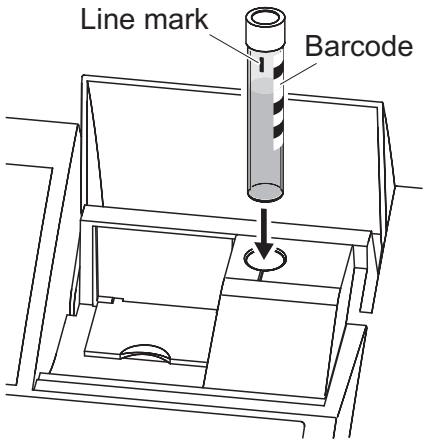
4.5 Measuring in *Concentration* mode

4.5.1 Measuring cell tests with barcode

<HOME>
Concentration



Inserting a cell with barcode starts a measurement.



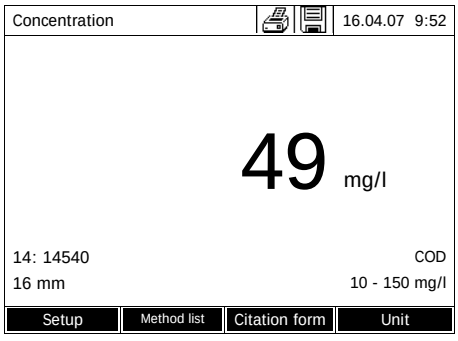
1 Open the cell shaft cover.

2 Close the inner turn-up lid.

If the inner turn-up lid is opened too wide, a message prompts you to close the inner turn-up lid.

3 Insert the barcoded round cell in the round cell shaft so it touches the bottom. When doing so, align the line mark with the notch at the front of the round cell shaft.

The photometer selects the method based on the bar code and automatically starts measurement.



4 Further options:

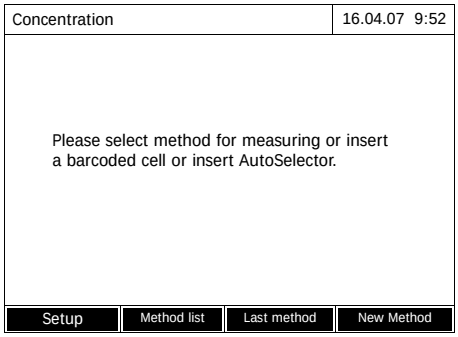
- Select a different citation form with *[Citation form]*, (e.g. NH_4 <–> NH_4-N).
- Select a different measuring unit with *[Unit]*, (e.g. mg/l <–> mmol/l).
- Make further settings such as dilution or blank value measurements with *[Setup]* (see section 4.5.6).

Display if the measured value is not within the measuring range (see section

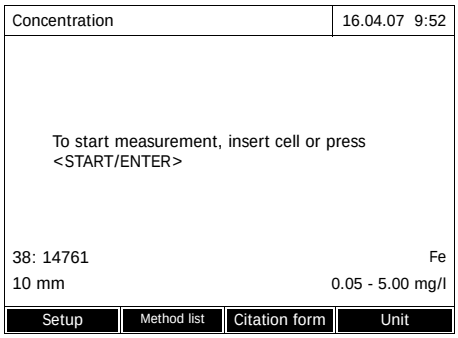
4.5.4).

4.5.2 Measuring reagent tests with AutoSelector

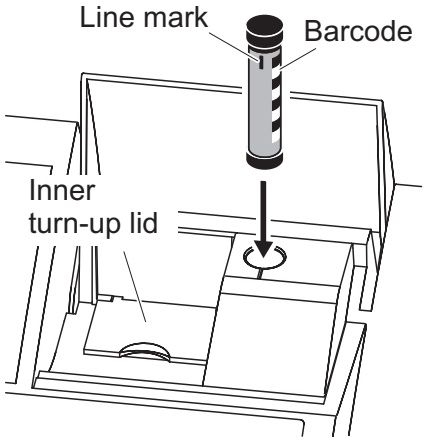
<HOME>
Concentration



The method is selected by inserting the AutoSelector.



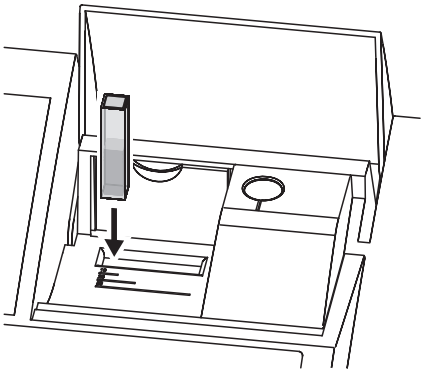
The photometer is ready to measure.



1 Open the cell shaft cover.

2 Insert the AutoSelector in the round cell shaft so it touches the bottom. When doing so, align the line mark with the notch at the front of the round cell shaft.

– The photometer selects the correct method with the aid of the barcode.



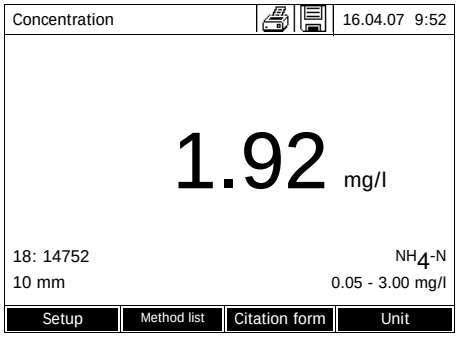
3 Open the inner turn-up lid.

4 Insert the rectangular cell vertically so it touches the bottom and left edge of the cell shaft. The opaque sides of the rectangular cell must point to the front and back.

The correct measuring range is automatically selected when the rectangular cell (1, 2, 5 cm) is inserted.

The photometer has an external light recognition. If there is too much external light, a message prompts you to close the cell shaft cover.

The photometer starts measuring automatically.



5 Further options:

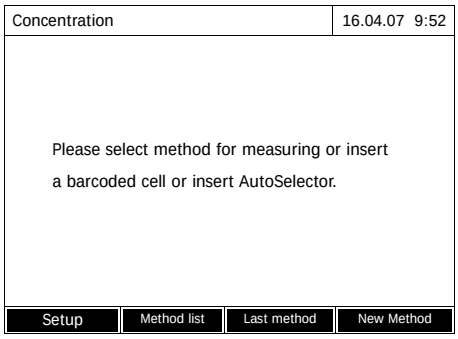
- Select a different citation form with *[Citation form]*, (e.g. NH_4 <–> NH_4-N).
- Select a different measuring unit with *[Unit]*, (e.g. mg/l <–> mmol/l).
- Make further settings such as dilution or blank value measurements with *[Setup]* (see section 4.5.6).

Display if the measured value is not within the measuring range (see section 4.5.4).

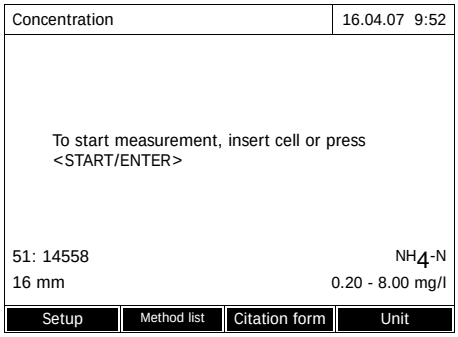
4.5.3 Measuring reagent-free tests and user-defined methods

User-defined methods and reagent-free methods normally do not have a barcode and therefore, no automatic method recognition. In such a case, select the method manually:

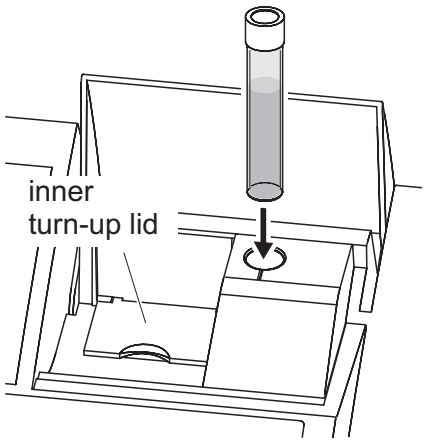
<HOME>
Concentration



1 Select the method manually (see section 4.5.5).



The photometer is ready to measure.



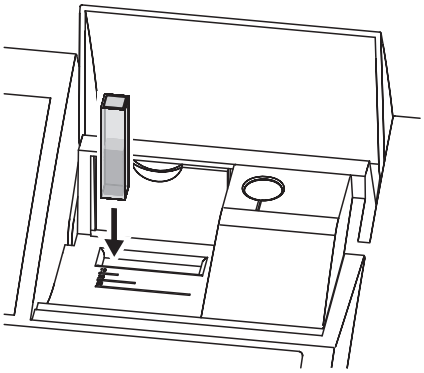
2 Depending on the type, insert the cell as follows:

Round cell:

Close the inner turn-up lid.

Insert the round cell in the round cell shaft so it touches the bottom.

If the turn-up lid is opened too wide, a message prompts you to close the inner turn-up lid.

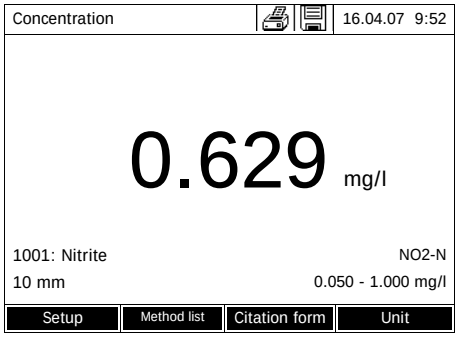


Rectangular cell:

Open the inner turn-up lid.

Insert the rectangular cell vertically so it touches the bottom and left edge of the cell shaft. The opaque sides of the rectangular cell must point to the front and back.

The photometer has an external light recognition. If there is too much external light, a message prompts you to close the cell shaft cover.



3 Further options:

- Select a different citation form with *[Citation form]*, (e.g. NH_4 <–> NH_4-N).
- Select a different measuring unit with *[Unit]*, (e.g. mg/l <–> mmol/l).
- Make further settings such as dilution or blank value measurements with *[Setup]* (see section 4.5.6).

Display if the measured value is not within the measuring range (see section 4.5.4).

4.5.4 Exceeding the upper or lower limits of the measuring range

Measured value display if the measured value is outside the measuring range:

Range		Display	Example: MR: 10 - 150 mg/l
	LL < **MV** < UL	Measured value	128 mg/l
1	UL < **MV** < UL + 10%	Upper limit of measuring range exceeded by up to 10% and measured value	> 150 157 mg/l
	LL - 50% < **MV** < LL	Lower limit of measuring range undercut by up to 50% and measured value	< 10 7 mg/l
2	**MV** > UL + 10%	Upper limit of measuring range exceeded by more than 10%	> 150 mg/l
	MV < LL - 50%	Lower limit of measuring range undercut by more than 50%	< 10
3	Invalid measured value e.g. **MV** < 0	Bars	- - - - mg/l

MR = Measuring range

UL = Upper limit value of the measuring range

LL = Lower limit value of the measuring range

MV = Measured value

4.5.5 Selecting a method manually

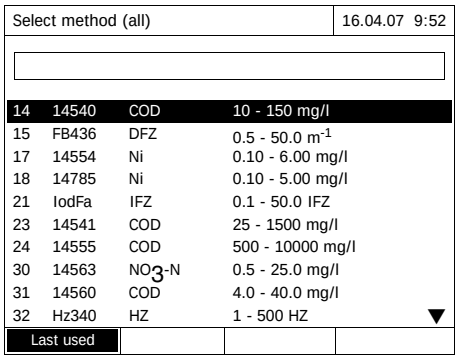
Selecting the method last used

<HOME>
Concentration
├ *[Last method]*

The method last used is immediately selected.

Selecting a method from the *Method list*

<HOME>
Concentration
├ *[Method list]*



The list of methods is displayed. The methods are ordered according to the method number. The arrows ▼ or ▲ on the right edge indicate that the list comprises more methods further up or down.

The method last selected is highlighted.

Select the method:

1 Select the required method with **<▲><▼>**. The active selection is displayed in reverse video.

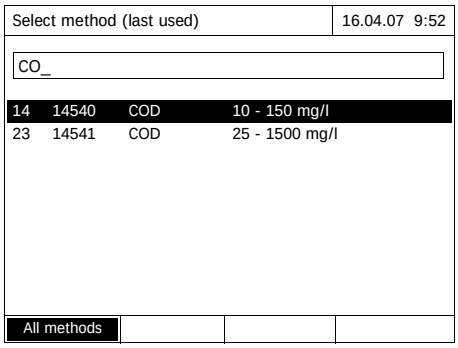
2 Accept the selection with **<START ENTER>**.

Narrowing down the method list

You can narrow down the method list and thus make the search easier:

- Using *[Last used]*, you can restrict the method list to the ten methods last used.
- With the search function you can search certain character strings in the list. The search takes place as a full-text search of the entire list contents. Thus you can search for a method number or certain citation form.

Search function



Search for a character string:

Enter the character string to be searched for in the search window with **<A...9>**.

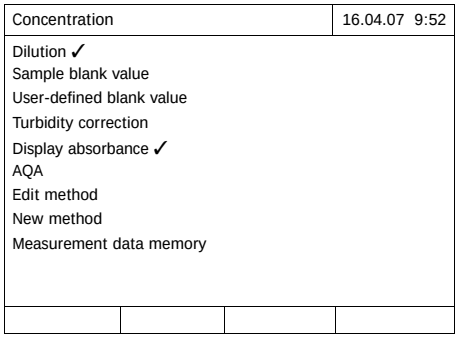
The list appearing below shows all hits containing the character string. The hit list is updated with each character that is entered.

Note
Note the case sensitivity when searching. It is not required or possible to enter inferior characters. When searching for chemical formulas, inferior characters are treated as normal characters. Example: The search for "NH4" shows all hits that contain "NH4" as well as "NH_4".

4.5.6 Settings for *Concentration* mode

Prior to measuring, check the settings for the selected method.

<HOME>
Concentration
Select a method
├ *[Setup]*



The menu shows an overview of all settings.

Active settings are marked by a check.

Overview of the settings

Menu item	Explanation
Dilution	Here you can set the dilution prior to measuring if you want to use a diluted sample. In the measured value display, the dilution is indicated in the form [1 + x] (parts sample + parts distilled water). For more detailed information on dilution, see section 4.5.7.
Sample blank value	Here you can measure while taking a sample blank value into account. In the measured value display, measurements with sample blank value are marked by [SB] (Sample blank). For more detailed information on sample blank value, see section 4.5.8.
User-defined blank value	If available, a user-defined reagent blank value is used. In the measured value display, measurements with a user-defined reagent blank value are marked by [BV/Lot number]. For more detailed information on reagent blank value, see section 4.5.9.
Turbidity correction	Activates/deactivates the automatic turbidity correction. In the measured value display, measurements with automatic turbidity correction are marked by [TURB]. For more detailed information on the automatic turbidity correction, see section 4.5.11.
Display absorbance	Activates/deactivates the display of the absorbance value in addition to the main measured value.
AQA	Here you can view and change the AQA settings without discarding the current measurement.
Edit method	Here you can edit user-defined methods.
New method	Here you can create user-defined methods.
Measurement data memory	Here you can view the measurement data memory.

4.5.7 Measuring diluted samples

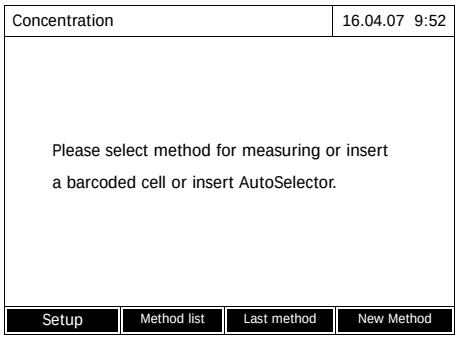
If the concentration of a sample exceeds the measuring range of a method, you can specifically dilute the sample so that the concentration of the diluted sample is in the measuring range of the method. Thus a valid measurement is possible.

After entering the factor for the dilution the meter converts the concentration to that of the undiluted sample.

Note
Optimum measurement results are achieved if the concentration of the diluted sample is in the middle of the measuring range of the method after diluting.

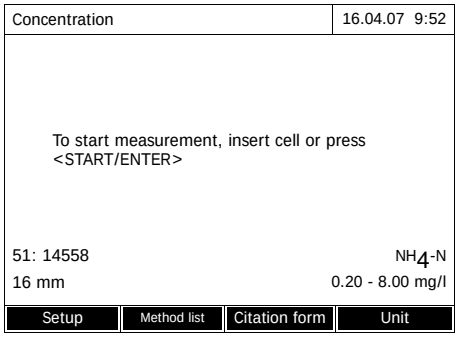
Setting the dilution

<HOME>
Concentration

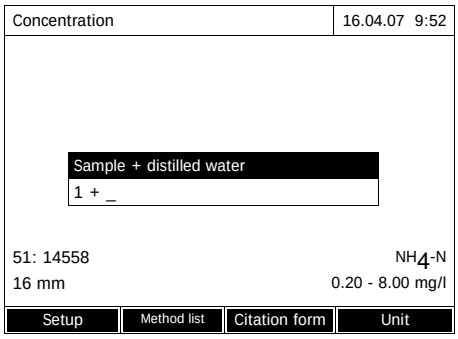


Inserting a cell with barcode starts a measurement.

If a cell without barcode is used: Select the method manually (see section 4.5.5).



The photometer is ready to measure.



1. Open the setting menu with *[Setup]*.
2. Select and confirm *Dilution*. The input field for the dilution pops up.
3. Enter and confirm the dilution (**<0...9>**).

   The entered dilution is taken into account with the next measurement.

The entered value for the dilution factor is valid for the selected method only. The dilution factor is erased if

- the photometer is switched off
- a different method is selected
- the factor 0 is entered in the *Dilution* menu.

If a dilution factor is active, it is indicated on the display during measurement in the form [1 + x].

4.5.8 Sample blank value

By measuring and using a sample blank value, measurement errors due to coloring and turbidity of the sample matrix can be eliminated to a large extent.

The sample blank value is a characteristic of the sample (coloration) to be currently determined. It is diluted according to the used method but does not contain any color reagents.
The pH value corresponds to that of the test sample.

Note
Due to the addition of reagents the sample is diluted. This can also change the pH value of the sample. For this reason the blank sample also has to be diluted and the pH value adjusted accordingly.

Validity

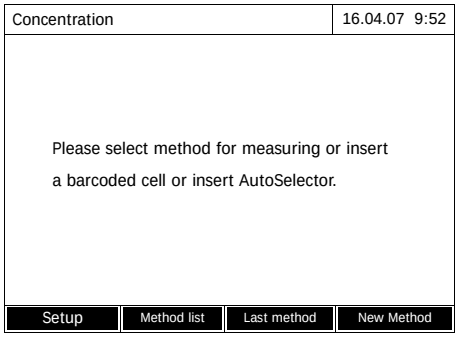
The sample blank value applies to the next measurement only.

Single and multiple determination

The sample blank value can be determined by single or multiple determination. With multiple determination, the sample blank value is calculated as the median from the individual measured values.

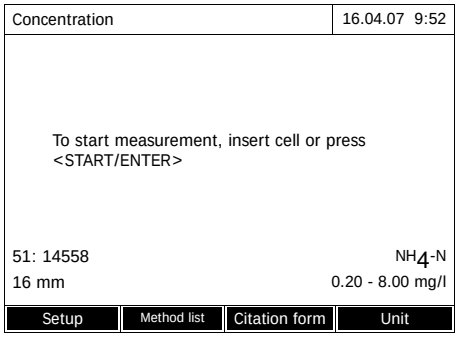
Measuring the sample blank value

<HOME>
Concentration



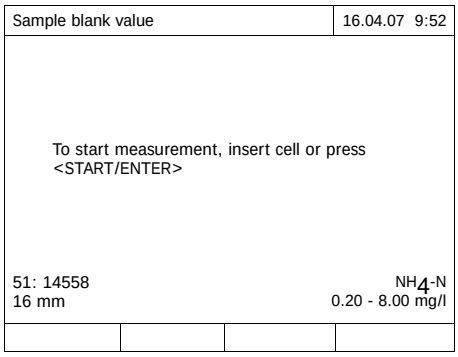
Inserting a cell with barcode starts a measurement.

If a cell without barcode is used:
Select the method manually (see section 4.5.5).



The photometer is ready to measure.

1. Open the setting menu with *[Setup]*.
2. Select and confirm *Sample blank value*.



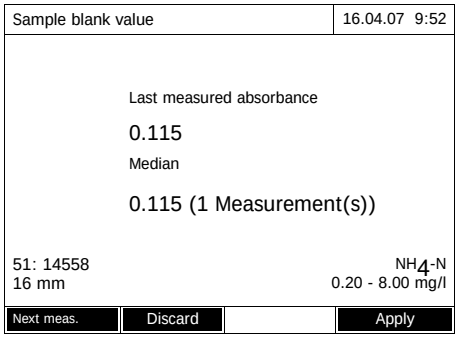
3 Insert the cell with a suitable blank sample.

The first single measurement for the sample blank value takes place.

The following data is displayed as the result:

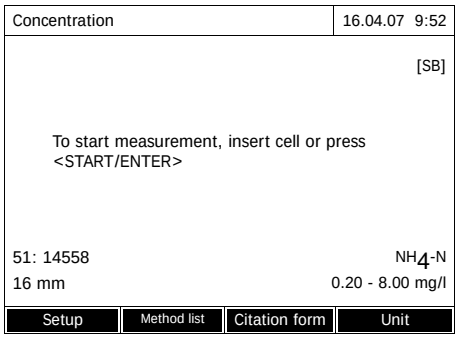
– The measured absorbance from the (last) single measurement.

– The median from all single measurements carried out up to now.



4 If necessary, carry out further single measurements for the formation of the median with *[Next meas.]*
or
discard the last single measurement with *[Discard]*.

5 To accept the median value, press *[Apply]*.



The photometer is ready to measure.

The use of the sample blank value is indicated by [SB] in the top right corner of the display.

4.5.9 Reagent blank value

The evaluation of the photometric measurement always refers to the comparison value of a test sample without the substance to be determined (reagent blank value). Thus the influence of the basic absorbance of the reagents on photometric measurement is compensated for.

In practice, the reagent blank value is measured with the same amount of deionized water instead of sample.

Factory and user-defined reagent blank values

With photometric concentration determination, the reagent blank value is a constant. The method data for all measurements with Merck Spectroquant® test sets (*Concentration* mode) include an exactly determined reagent blank value. This value is overwritten if you measure the reagent blank value yourself (setting, *User-defined blank value*, see section 4.5.6).

Note
You can increase accuracy if you determine the reagent blank value with a test of a new lot and use the reagent blank value for all further measurements with this lot. This is especially recommended for measurements in the vicinity of the lower limit of the measuring range. To be able to attribute the reagent blank value in the measured value documentation later, you can enter the lot number of the reagent package (*Lot number*) during the blank value determination.

Validity

The factory blank values always remain stored in the meter and can be activated at any time. The reagent blank values you measured yourself also remain stored in the meter until they are overwritten by a new blank value measurement.

Single and multiple determination

The reagent blank value can be determined with single or multiple determination. With multiple determination, the reagent blank value is calculated as the median from the individual measured values.

User-defined methods

For user-defined methods, you can activate the reagent blank value function as follows only:

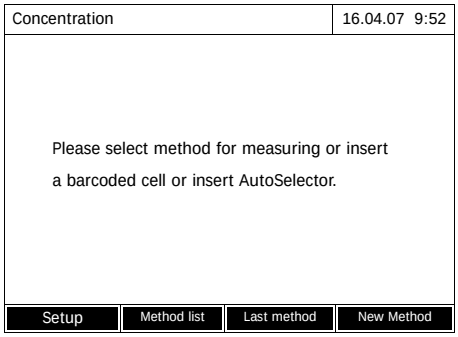
Entry type	Function type	Reagent blank value possible?
Entry of a function (with and without entering the ordinate intercept)	Linear	Yes
	Nonlinear	No
Entry of value pairs or measurement and storage of standard solutions (with entering/measuring and storing E0)	Linear	Yes
	Parabola (second-order function)	Yes
	Polygon line	No
Entry of value pairs or measurement and storage of standard solutions (without entering/measuring and storing E0)	Linear	Yes
	Parabola (second-order function) Polygon line Polygon line through zero	No

Note

If no value for E0 is stored during the entry of value pairs or the measurement and storing of standard solutions for a nonlinear function (parabola or polygon line), the message, *No blank value correction is intended for this method.* appears when the *User-defined blank value* function is activated. The blank value (E0) can be entered later by editing the method.

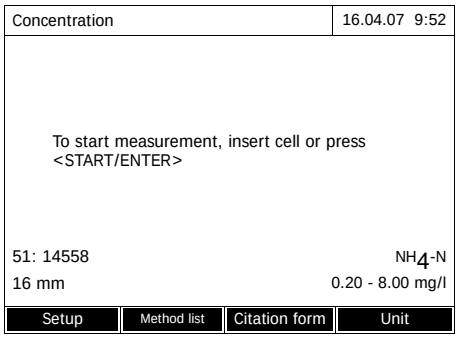
Measuring the reagent blank value

<HOME>
Concentration

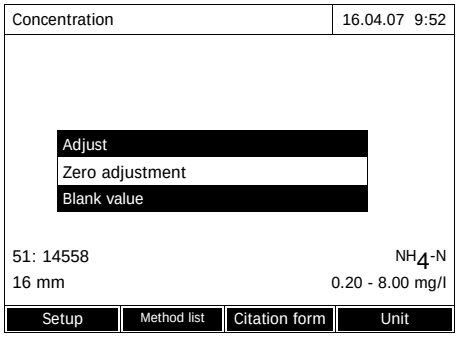


Inserting a cell with barcode starts a measurement.

If a cell without barcode is used: Select the method manually (see section 4.5.5).

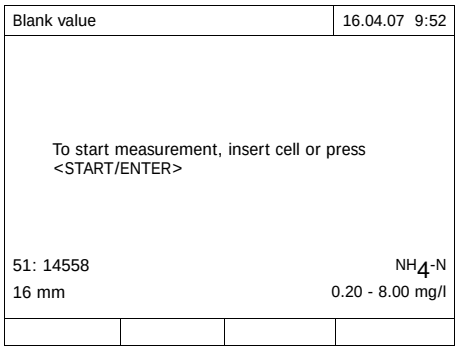


The photometer is ready to measure.



1. Using **<BLANK ZERO>**, open the *Adjust* selection list.
2. Select and confirm *Blank value*.

   The window for the measurement of the reagent blank value pops up.
   The data of the last measurement appears in the measured value display.



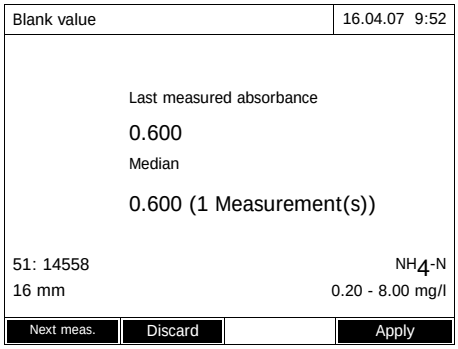
3 Insert the cell with the blank sample.

The first single measurement for the reagent blank value takes place.

The following data is displayed as the result:

– The measured absorbance from the (last) single measurement.

– The median from all single measurements carried out up to now.

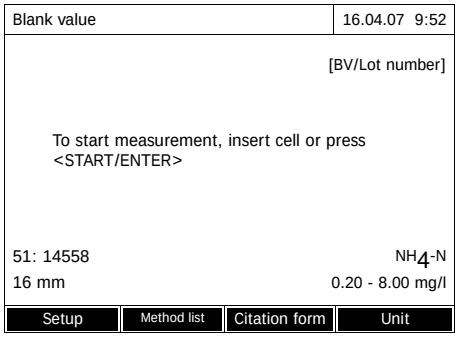


4 If necessary, carry out further single measurements for the formation of the median with *[Next meas.]*
or
discard the last single measurement with *[Discard]*.

5 To accept the median value, press *[Apply]*.

The *Lot number* entry field pops up.

6 Enter and confirm the *Lot number* (**<A...9>)**.
The blank value measurement is completed.



The photometer is ready to measure.

The use of the reagent blank value is indicated by [BV/Lot number] in the top right corner of the display.

4.5.10 User calibration (standard adjustment)

Some methods for concentration measurement provide the option to optimize the original calibration stored with the method by means of a user calibration.
When creating a used-defined method you can also allow a user calibration (see section 4.5.12).

A user calibration is only valid if the difference compared to the original calibration is no more than 30%.

The absorbance measurement for a user calibration can be carried out as a single or multiple determination. With multiple determination, the absorbance is calculated as the median from the individual measured values.

When a method is called up for which a user calibration is possible, a query appears whether or not the user calibration should be carried out.
When a method is called up for which a user calibration is required, measurement is only possible with a valid user calibration.

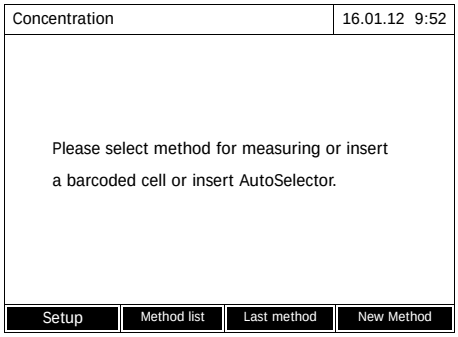
The usage of the user calibration is documented with the measured value and indicated in the measured value display with [Cal].

Validity A user calibration is always stored for the method presently called up. A user calibration is only erased if

- a new user calibration is carried out
- the original calibration is selected for measurement
- the user calibration is manually erased
- the photometer is reset to the default condition.

Carrying out a user calibration

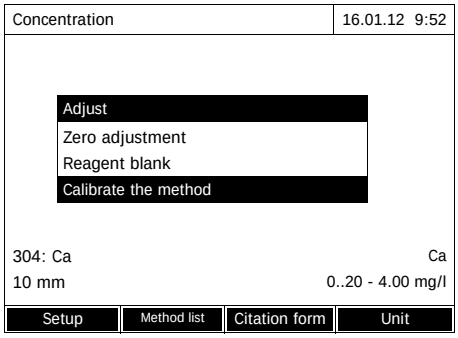
<HOME>
Concentration



Select the method manually (see section 4.5.5).

If there are already data for the zero adjustment, reagent blank value or a user calibration available, the photometer informs you of this. You can take over or discard the available values.

With methods that are not bar coded the photometer refers to the first execution of a zero adjustment.



1 Using **<BLANK ZERO>**, open the *Adjust* selection list.

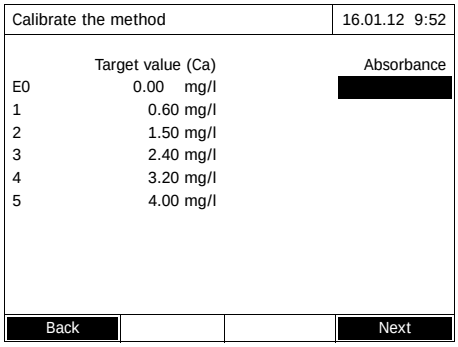
or

Open the setting menu with *[Setup]*.

2 Select and confirm *Calibrate the method*.

If data of a user calibration are available, the list displays the calibration data of the last user calibration for each of the standard solutions.

If there are no data of a user calibration, the list for measuring the *Absorbance* for all calibration standards required appears.

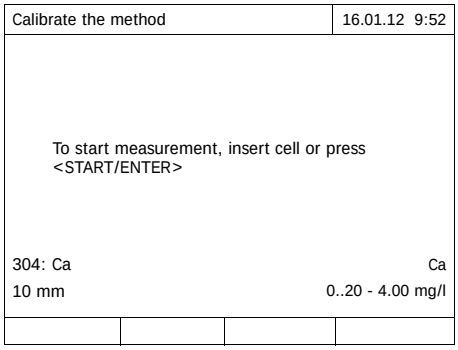


3 In the *Target value* column, enter the nominal values of the individual standard solutions.

The nominal value for E0 (reagent blank value) is preset and cannot be changed. The respective absorbance has to be measured.

4 Select an absorbance value and confirm with **<START ENTER>**.

The measurement window pops up.



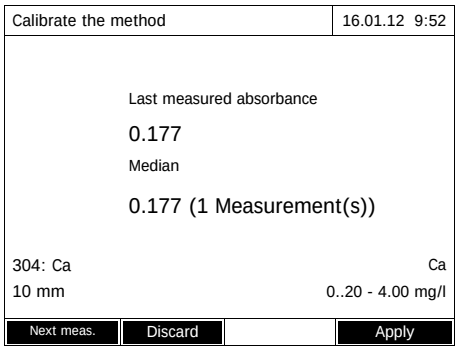
5 Insert the cell with the relevant standard or the reagent blank value (for E0).

The first single measurement for the calibration is carried out.

The following data is displayed as the result:

– The measured absorbance from the (last) single measurement.

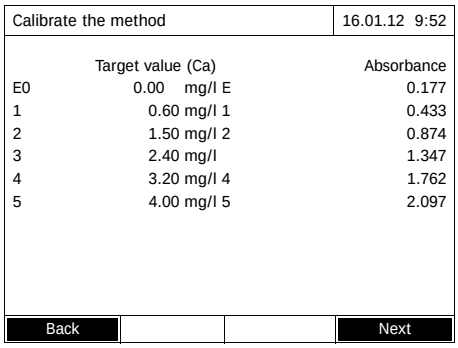
– The median from all single measurements carried out up to now.



6 If necessary, carry out further single measurements for the formation of the median with *[Next meas.]*
or
discard the last single measurement with *[Discard]*.

7 To accept the median value, press *[Apply]*.

The list of the standards required for this method pops up. The absorbance measured for the standard or reagent blank value respectively (E0) is entered.



8 In the *Absorbance* column, select all fields one after the other and start the respective measurement with **<START ENTER>**.

When all values have been measured (also the reagent blank value E0):

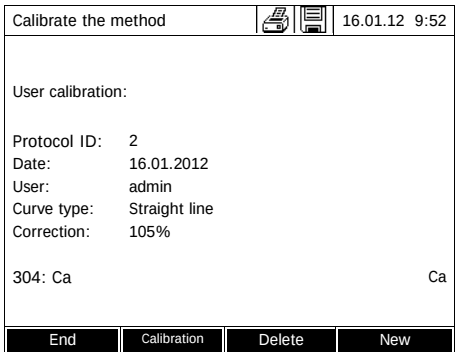
9 Accept the values with *Next*.

The result of the calibration pops up.

If necessary, display the list with the value pairs of nominal value and absorbance with *Calibration data*.

If necessary, display the calibration curve in the window of the value pairs with *Graphic*.

10 Accept the calibration with *Apply*.



If necessary, display the list with the value pairs of nominal value and absorbance with *Calibration data*.

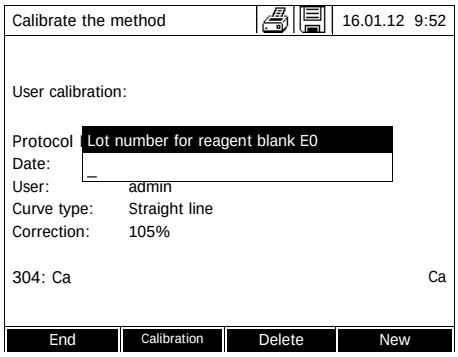
If necessary, display the calibration curve in the window of the value pairs with *Graphic*.

If necessary, erase the user calibration with *Delete*.

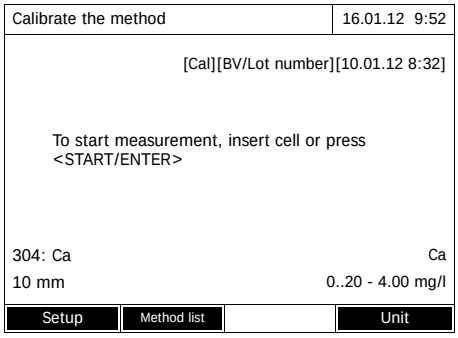
If necessary, carry out a new user calibration with *New measurement*.

11 Finish the calibration with *End*.

The *Lot number* input field for entering the *Lot number* of the reagent blank value (E0) pops up.



12 Enter the *Lot number* of the reagent blank value (**<A...9>)** and confirm.
The user calibration is completed.



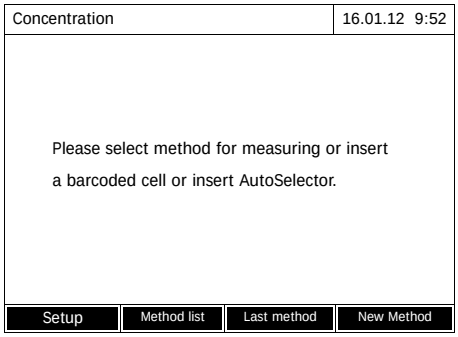
The photometer is ready to measure.

If the user calibration is used, the [Cal] indicator appears on the display.

Note: calibration is unsuccessful if the new value deviates by more than 30% from the value of the stored calibration.

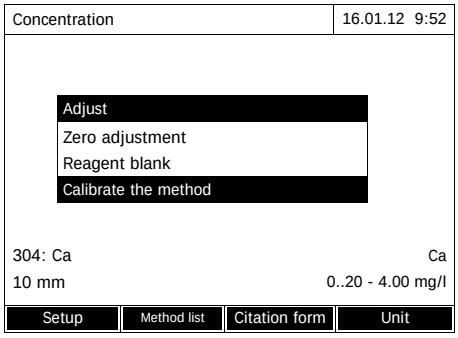
Viewing the data of the user calibration

<HOME>
Concentration



Select the method manually (see section 4.5.5).

If there are already data for the zero adjustment, reagent blank value or a user calibration available, the photometer informs you of this. You can take over or discard the available values.



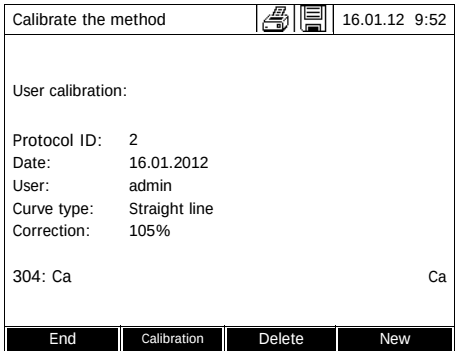
1 Using **<BLANK ZERO>**, open the *Adjust* selection list.

or

Open the setting menu with *[Setup]*.

2 Select and confirm *Calibrate the method*.

The *Calibrate the method* window pops up.
The data of the last measurement appear in the window.



If necessary, display the list with the value pairs of nominal value and absorbance with *Calibration data*.

If necessary, display the calibration curve in the window of the value pairs with *Graphic*.

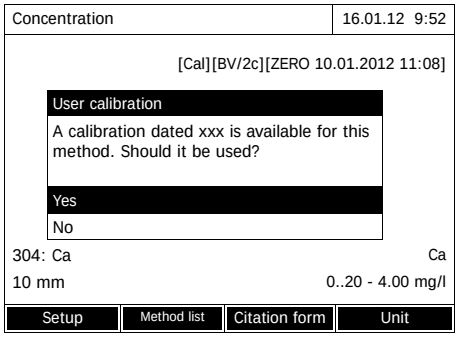
If necessary, erase the user calibration with *Delete*.

If necessary, carry out a new user calibration with *New measurement*.

If necessary, finish the calibration with *End*.

Measuring with user calibration

<HOME>
Concentration

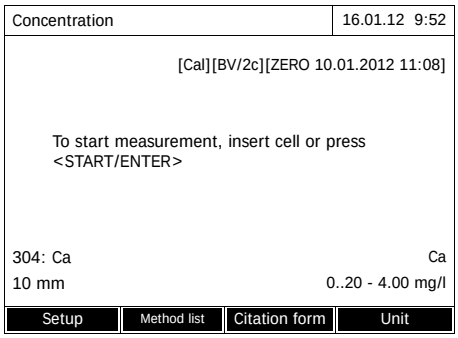


Select the method manually (see section 4.5.5).

If there are already data for the zero adjustment, reagent blank value or a user calibration available, the photometer informs you of this. You can take over or discard the available values.

If the available user calibration should not be used, a query with further options pops up:

- *Use default calibration*
  The existing user calibration is erased. Further measurements will be carried out with the original calibration stored with the method
- *Recalibrate*
  The existing user calibration is erased. A new user calibration is started.
- *Cancel*
  The existing user calibration remains stored. The previous query is displayed.



The photometer is ready to measure after all the necessary data have been confirmed or measured.

4.5.11 Automatic Turbidity correction

The *Turbidity correction* function activates the automatic recognition and compensation of the light absorption caused by turbid substances.

After activating the function remains permanently switched on. Measured values that were measured with *Turbidity correction* are labeled with [TURB] (turbidity correction) on the display and in the documentation (printout and memory).

The *Turbidity correction* function is not active in the delivery condition.

Note
The setting for automatic turbidity correction is used with all methods where the automatic turbidity correction makes sense. The photometer automatically decides whether or not to use the function.

Switching on the turbidity correction

The automatic turbidity correction is activated and deactivated in the setting menu of the concentration measurement (see section 4.5.6 SETTINGS FOR CONCENTRATION MODE).

4.5.12 Programming / modifying user-defined methods

Overview

For *Concentration* mode, you can develop and store yourself user-defined methods under the method numbers 1001 to 1100. The photometer software supports you when creating the methods.

Calibration data and calibration function

In photometry, the calibration function describes the dependency between the measured parameter (e.g. concentration) and the photometric measurement result (e.g. absorbance) of a sample. The knowledge of this dependency is a prerequisite for the development of a photometric method. The calibration function is usually determined by means of a series of measurements with standard solutions of known concentrations (nominal value), e.g. a 10-point calibration.

Note
In measuring operation, the reverse calibration function is used to output the measured absorbance as a concentration value.

Line types

The dependency between the nominal value and absorbance is often linear in a wide range as shown in the following example:

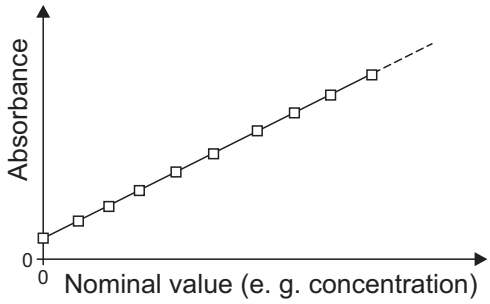


figure 4-2 Example of a linear calibration function after a 10-point calibration

In the case of a linear dependency, the calibration function is determined by means of linear regression. The slope and axis intercept (E0) are the characteristics of the calibration line.

In the case of a nonlinear dependency, the points of the measuring ranges can be connected to each other as a polygon line or approximated as a parabola:

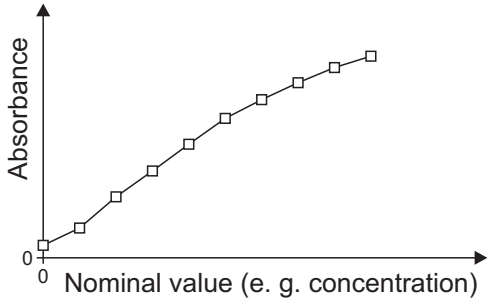


figure 4-3 Example of a polygon line calibration function after a 10-point calibration

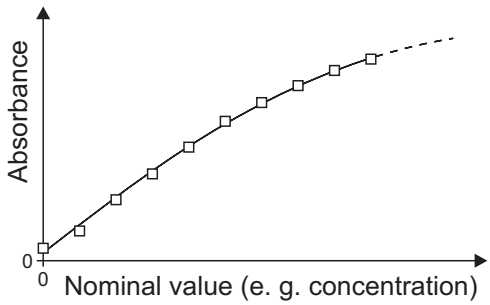


figure 4-4 Example of a parabola calibration function after a 10-point calibration

Determining the calibration function

You have the following options to create a method:

- **Measure and store:**
  Carry out a series of measurements with the following sample solutions while at the same the photometer takes over the values:
  - Blank sample to determine the reagent blank value (with deionized water instead of sample, see section 4.5.9)
  - at least one, up to ten standard solutions in different concentrations.

  The photometer stores nominal value/absorbance value pairs of the individual measurements and determines the resultant characteristics of the calibration. When doing so, you can select the following line types: *Polygon line*, *Straight line* or *Parabola*.
- **Enter as value pairs:**
  Entry of the value pairs, Nominal value (concentration) / Measured absorbance of an already available test series with the following sample solutions:
  - Blank sample to determine the reagent blank value (with deionized water instead of sample, see section 4.5.9)
  - at least one, up to ten standard solutions in different concentrations.

  Based on the entered value pairs, the photometer determined the characteristics for the calibration. When doing so, you can select the following line types: *Polygon line*, *Straight line* or *Parabola*.
- **Enter a function:**
  Entry of a function to calculate the concentration from the absorbance (reverse calibration function). You can enter on the photometer the coefficients of a polynomial equation of the following type:

$$c = a0 + a1 \cdot A + a2 \cdot A^2 + a3 \cdot A^3 + a4 \cdot A^4 + a5 \cdot A^5$$

with:

c	Measurement result, e.g. concentration
a0 to a5	Coefficients (input range 0.000 to 1000,000)
A	Absorbance

Note
Entering the formula is especially simple if you measure with a commercial test set for which the manufacturer has given the value for the coefficients a1. It is often called the "Factor" and corresponds to the reciprocal value of the slope of the straight line of the calibration function.

If a linear function (straight line) should be entered, it is necessary to enter the coefficients a0 and a1 to receive correct measured values.

If the exact value for a0 is not known at the time the formula is entered, it is sufficient to enter the coefficient a1. In this case, the *User-defined blank value* function (in the *Concentration* / *Setup* menu) has to be activated to measure with this method.
Prior to measuring with this method, a blank value measurement has to be carried out. This procedure determines the value for a0, which then replaces the value from the programming of the method.
If the *User-defined blank value* function is not activated, the photometer uses the value zero for the coefficient a0.

More information on the entry of the formula (determination of coefficients)

Linear function

If the value for a1 (slope of the reverse calibration function) is unknown, you can very simply program the method in the photometer by measuring/storing or entering the value pairs (see above).

For entry as a formula, you can determine the coefficients of the reverse calibration function by linear regression. When doing so, the concentration has to be on the Y axis and the absorbance on the X axis.

In the case of a linear function, the coefficients of the reverse calibration function can also be determined from the determined reagent blank value and the slope (m) of the calibration function (Y axis = absorbance, X axis = concentration). Proceed as described below.

Explanation of the coefficients of the formula:

- *a0* = - E0*a1
  [E0 = reagent blank value
  (absorbance at concentration 0)]
- *a1* = 1/m
  Reverse value of the slope of the calibration function
  (often referred to as "Factor")
  m = slope of the calibration function
- *a2, a3, a4, a5* = further coefficients
  (when entering a linear function: zero)

Nonlinear function

The coefficients of the reverse calibration function are determined by multiple regression. When doing so, the concentration has to be on the Y axis and the absorbance on the X axis.

Further method data

Input field	Possible entries
*Number**	1001 ... 1100
Designation	Any name (max. 18 characters)
Version	Any version designation (max. 18 characters)
*Wavelength**	Freely selectable (in nm)
*Cell**	16 (round), 10, 20 or 50 mm
Citation form	e.g. PO4-P (max. 18 characters)
*Unit***	e.g. mg/l (max. 18 characters)
*Resolution**	0.001, 0.01, 0.1 or 1
Lower and upper limit of the measuring range *	Any value between zero and the highest concentration of the used standard solutions
Timer 0 to 3	Up to four analysis timers freely adjustable
AQA2 target value	Any value within the measuring range
AQA2 tolerance	Any
Required measurements	1 or greater Number of measurements after which a measured value is documented. With more than one measurement, the documented measured value is the median from all measurements.
Blank required	*Yes* / *No*
Calibration possible	*Yes* / *No*
Calibration required	*Yes* / *No*

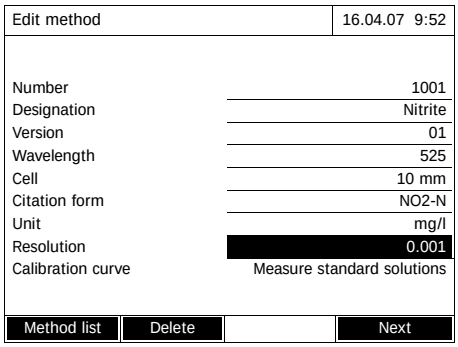
* necessary inputs
** default: mg/l

Note
If a nonlinear calibration curve is programmed for a method, it may occur that the presetting of the following menu items cannot be changed:

- *Blank required*
- *Calibration possible*
- *Calibration required*

How to program user-defined methods

<HOME>
Concentration
├ *[Setup]*
  ├ *New method*



1 Enter the general method data here. The next available method number is already entered as the number.

You have the following options when filling out the input fields:

- Fill out all empty input fields one after the other
- Using *[Method list]*, select an already existing method as a model, give it a new method number and adjust the entries
- Using *[Method list]*, select an existing method in order to change it (without changing the number).
- You can delete the method completely with *[Delete]*.

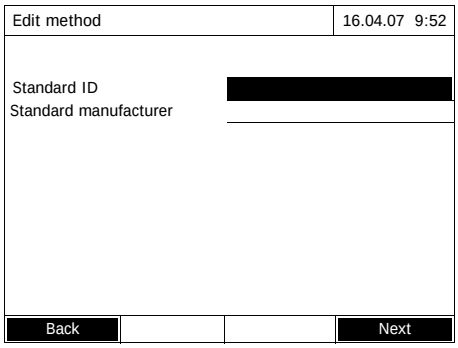
2 Select the menu item, *Calibration curve*. Select the method for the determination of the calibration line. The following variants can be selected:

- *Measure standard solutions*
- *Enter value pairs*
- *Enter formula*

3 Using *[Next]*, accept all entries on the page and switch to the next page.

Note
During the following proceeding, you can return to the previous page at any time with *[Back]*, e. g. if you want to correct entries, add further value pairs or eliminate outliers.

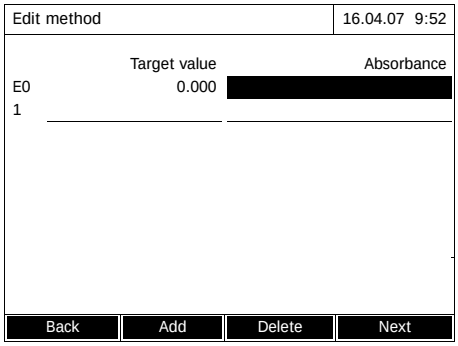
Variant 1: *Measure standard solutions*



1 Select and confirm *Measure standard solutions*.

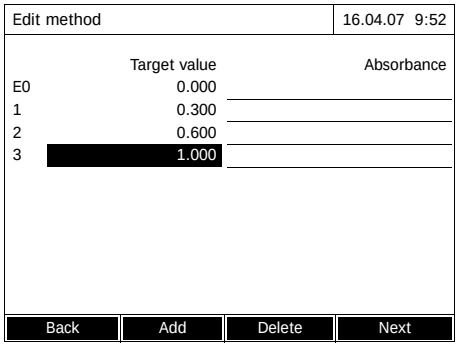
2 Enter and confirm details of the standard solutions (optional).

3 Using *[Next]*, accept all entries on the page and switch to the next page.



The table for the measurement of standard solutions pops up.

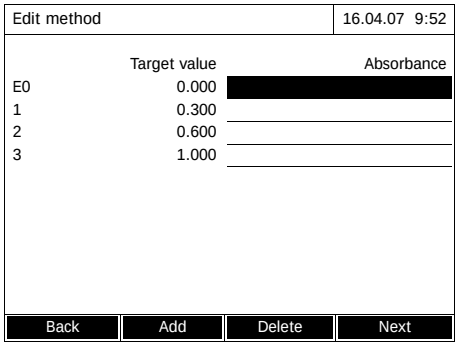
In the first two lines of the table, the two value pairs (measuring points) that are at least required for a calibration are already prepared (reagent blank value E0 and any further nominal value).



4 Create further values pairs with *[Add]* as necessary.

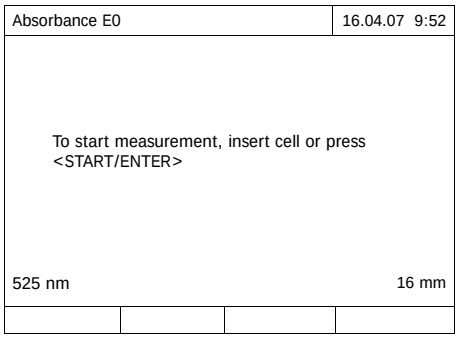
You can delete a highlighted value pair with *[Delete]*.

5 In the *Target value* column, enter the nominal values of the individual standard solutions.



Measuring the standard solutions:

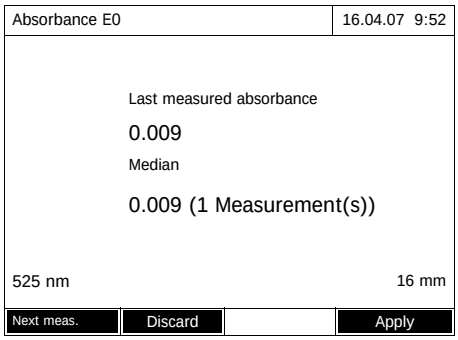
6 Using the arrow keys **<▲><▼>** and **<◀><▶>**, navigate to the relevant input field in the *Absorbance* column and press **<START ENTER>**.



The measurement display appears.

7 Insert the cell with the respective standard.

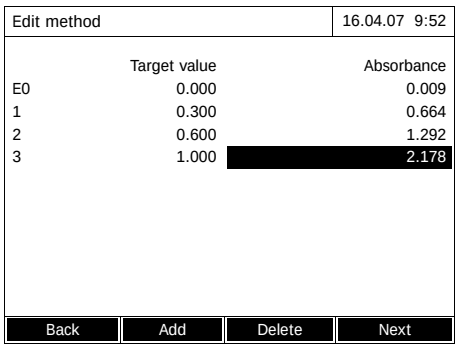
The absorbance is measured. The result of the first single measurement is displayed.



8 If necessary, carry out further single measurements for the formation of the median with *[Next meas.]*
or
discard the last single measurement with *[Discard]*.

9 To accept the median value, press *[Apply]*.

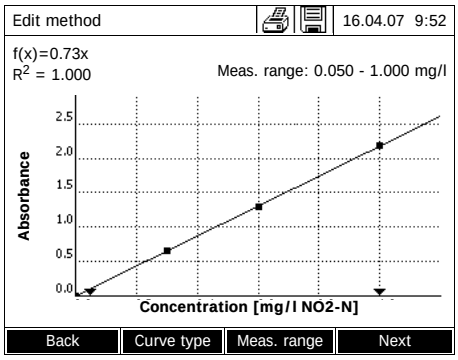
Note
If the zero standard concentration (reagent blank value E0) is not measured and stored, the photometer calculates the calibration line without this value. If the *User-defined blank value* function (in the *Concentration* / *Setup* menu) is activated for measuring with this method, the value for a0 is determined and replaces the calculated axis intercept from the programming of the method.



10 Repeat the steps 6 to 9 until all input fields in the *Absorbance* column are filled out.

11 Using *[Next]*, accept all entries on the page and switch to the next page.

The value pairs are displayed in a diagram (standard: Polygon line).



The related formula f(x) and correlation coefficient R^2 are displayed above the diagram.

12 If required, select a different line type for the line adjustment with *[Curve type]*.

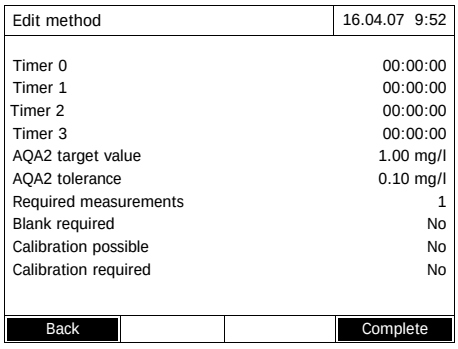
- *Polygon line*
- *Straight line*
- *Parabola*

13 If required, enter different measured value limits with *[Meas. range]*.

- *Lower limit*
- *Upper limit*

14 Using *[Next]*, complete the editing of the calibration line and proceed to the next page.

The timers and AQA2 data linked to the method are displayed.



15 If necessary, enter intervals for up to 4 timers.

16 If necessary, enter the *AQA2 target value* and *AQA2 tolerance*.

17 If necessary, select from how many single measurements the documented measured value is calculated.

18 If necessary, set whether a reagent blank value is required.

19 If necessary, set whether a user calibration is possible and/or required.

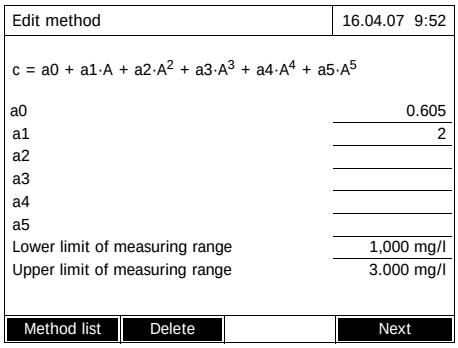
20 Complete the programming of the method with *[Complete]*.

The method is programmed and selected for measuring.

Variant 2:
Enter value pairs

Unlike variant 1, the fields of the *Absorbance* column are filled out manually here. Accordingly, the steps 6 to 10 are not applicable here. Apart from that, the proceeding is identical to variant 1.

Variant 3:
Enter formula



1 Select and confirm *Enter formula*.

Input fields for the coefficients (a0 ... a5) of the formula are displayed.

2 Enter and confirm the factors.

If no value is entered for a coefficient the photometer automatically uses the value 0.

Note

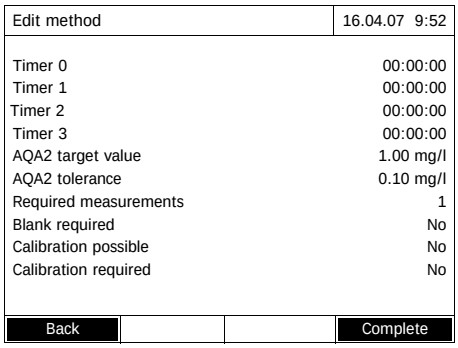
Entering the formula is especially simple if you measure with a commercial test set for which the manufacturer has given the value for the coefficients a1. It is often called the "Factor" and corresponds to the reciprocal value of the slope of the straight line of the calibration function.

If a linear function (straight line) should be entered, it is necessary to enter the coefficients a0 and a1 to receive correct measured values.
If the exact value for a0 is not known at the time the formula is entered, it is sufficient to enter the coefficient a1. In this case, the *User-defined blank value* function (in the *Concentration* / *Setup* menu) has to be activated to measure with this method. Prior to measuring with this method, a blank value measurement has to be carried out. During this procedure the value for a0 is determined and replaces the previous value.

3 Enter and confirm the measuring range limits.

4 Complete the entering of the formula with *[Next]*.

The timers and AQA2 data linked to the method are displayed.



5 If necessary, enter intervals for up to 4 timers.

6 If necessary, enter the *AQA2 target value* and *AQA2 tolerance*.

7 If necessary, select from how many single measurements the documented measured value is calculated.

8 If necessary, set whether a reagent blank value is required.

9 If necessary, set whether a user calibration is possible and/or required.

10 Complete the programming of the method with *[Complete]*.

The method is programmed and selected for measuring.

4.6 Measuring the Absorbance / % Transmission

4.6.1 General information

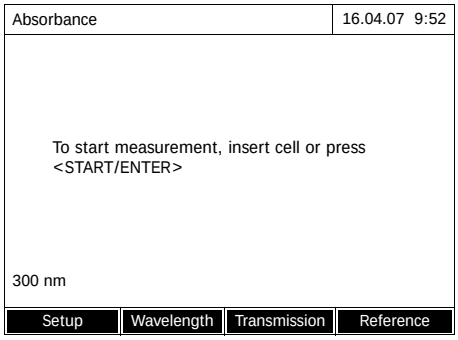
The absorbance or transmission respectively is measured without the use of any methods or profiles. All settings are configured during measurement.

Measuring against the Reference absorbance

The absorbance or transmission can alternatively be measured against the absorbance of the zero adjustment or against a *Reference absorbance* determined by yourself (see section 4.6.3 MEASURING AGAINST THE REFERENCE ABSORBANCE).

4.6.2 Measuring the absorbance or transmission

<HOME>
Absorbance / % Transmission



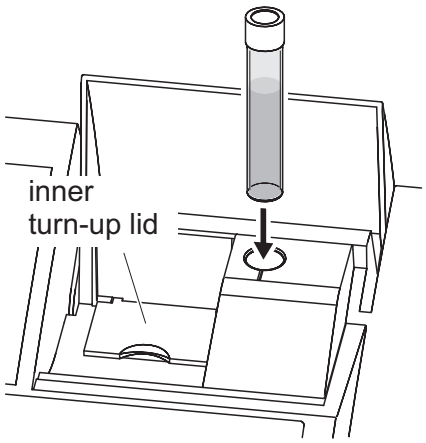
The settings of the last measurement are active.

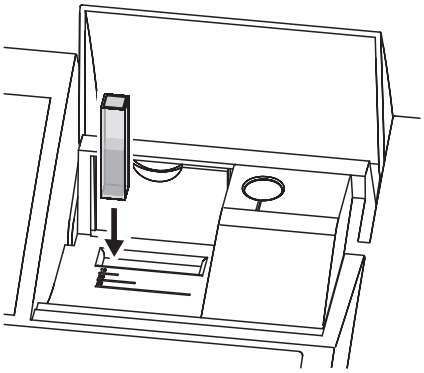
1. Using *[Wavelength]*, change the wavelength as necessary.
2. Using *[Absorbance]* <–> *[Transmission]*, you can switch over between absorbance and transmission measurement.
3. If necessary, use or measure a reference measurement with *[Reference]* (see section 4.6.3).
4. Depending on the type, insert the cell as follows:

   Round cell:

   Insert the round cell in the round cell shaft so it touches the bottom.

   If the inner turn-up lid is opened too wide, a message prompts you to close the inner turn-up lid.





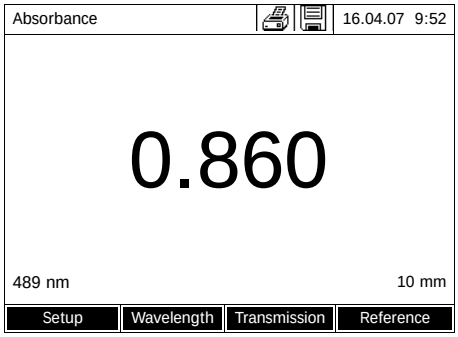
Rectangular cell:

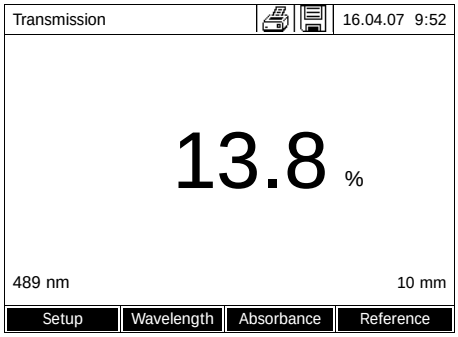
Open the inner turn-up lid.

Insert the rectangular cell vertically so it touches the bottom and left edge of the cell shaft. The opaque sides of the rectangular cell must point to the front and back.

The photometer has an external light recognition. If there is too much external light, a message prompts you to close the cell shaft cover.

The photometer starts measuring automatically.





5 Using *[Absorbance] <–> [Transmission]*, switch over the display from *Absorbance* to *Transmission* or vice versa.

4.6.3 Measuring against the Reference absorbance

Each time the photometer is switched on, the absorbance or transmission is measured against the absorbance of the zero adjustment as a basis. You can, however, also determine a *Reference absorbance* and use it as the basis.

The *Reference absorbance* refers to the adjusted wavelength. The measured value remains stored until

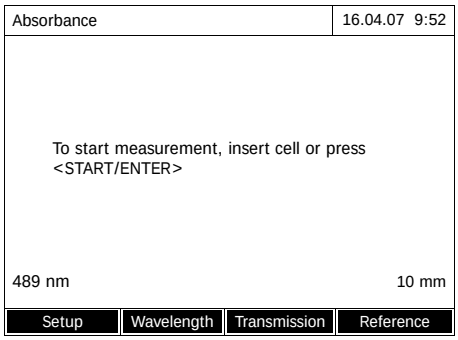
- the photometer is switched off
- the cell type is changed
- the wavelength is changed
- a new reference value is measured
- it is deleted manually (*[Reference]* / *Delete*).
- the *Absorbance / % Transmission* measuring mode is exited

Single and multiple determination

The Reference absorbance can be determined with single or multiple determination. With multiple determination, the mean value is calculated as the median from the individual measured values.

Measuring the Reference absorbance

<HOME>
Absorbance / % Transmission

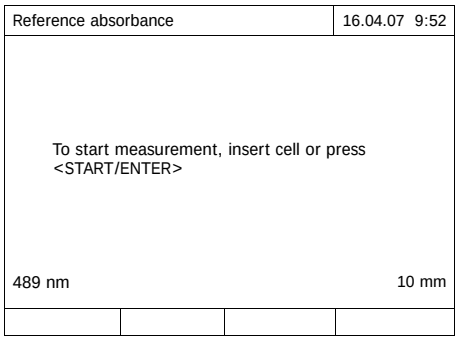


The settings of the last measurement are active.

1 Start the reference measurement with *[Reference]*.

If a value for the reference absorbance is already stored, it can be deleted or overwritten by a new reference measurement.

After the reference absorbance value has been deleted, the photometer measures against the absorbance of the zero adjustment.



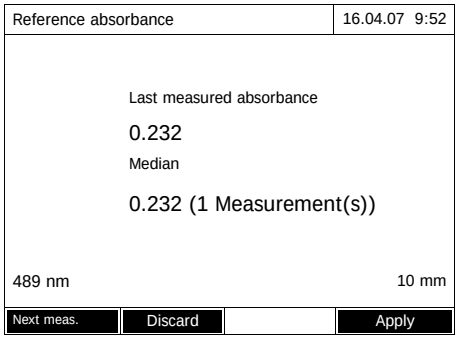
2 Insert the cell with the reference sample.

The first single measurement for the Reference absorbance is carried out.

The following data is displayed as the result:

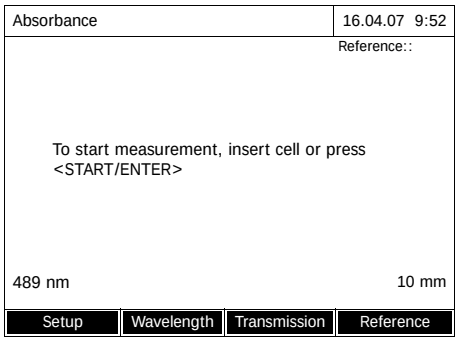
– The measured absorbance from the (last) single measurement.

– The median from all single measurements carried out up to now.



3 If necessary, carry out further single measurements for the formation of the median with *[Next meas.]*
or
discard the last single measurement with *[Discard]*.

4 To accept the median value, press *[Apply]*.



The photometer is ready to measure.

The reference absorbance is displayed in the top right corner during absorbance or transmission measurement.

4.7 Special / Multi wavelengths methods

4.7.1 Basic information on Special / Multi wavelengths measurements

In the Special / Multi wavelengths mode of the Spectroquant® Pharo 300, you can carry out measurements with special methods and functions.

You can use the following functions for these methods:

- Measurements at different wavelengths
- Multiple measurements at one wavelength (e.g. before and after adding a reagent)
- Use of procedure variables.
  Procedure variables provide a value that has to be entered prior to each measurement on the photometer (e.g. volume, pH value or temperature)
- Check whether a value meets a condition.
  With a condition you can check a value for validity (e.g. absorbance value, procedure variable or the result of a formula).
- Formula editor for the convenient programming of any user-defined methods

Special methods

The method list in the Special / Multi wavelengths mode comprises:

- preprogrammed multi wavelengths methods
- preprogrammed special methods
- special methods programmed by the user

Note
If you program any special methods yourself, you can use all extended functions of the Special / Multi wavelengths mode.

4.7.2 Programming / modifying the Special / Multi wavelengths methods

Note
For multi wavelength methods, you can use the method numbers 2001 to 2050. All special methods can also be selected in the method list of the concentration mode.

The creation of a user-defined method is done in the following steps:

- **Enter the general method data**
  Method number, method name, unit etc.
- **Enter the wavelengths for absorbance measurements ($A_{x\ nm}$)**
  Minimum 1, maximum 10
- **Define the procedure variables** (K_X) **(optional)**
  Procedure variables are used to take into account any influence quantities that cannot be measured by the photometer.
  The values for these procedure variables have to be entered for all measurements with the method, e.g. the temperature or pH value.
- **Enter the formula to calculate the measurement result**
  Enter the formula with which you want to calculate the measurement result in the formula editor.
- **Enter an additional condition (optional)**
  Conditions are used to check the measurement result for validity.
  The condition is entered with the formula editor.

Example: Determination of chlorophyll a according to Nusch

The chlorophyll determination is based on two measurements (before and after adding an acid) of the optical density (= absorbance) of the extract of an aqueous sample at 665 nm.

$$Chlorophyll\ a\ (\mu g/l) = 29.6 * (A_{(before)\ 665\ nm} - A_{(after)\ 665\ nm}) * (V_{Extract}/V_{Sample})$$

with:

$A_{(before)\ 665\ nm}$	1st absorbance measurement at 665 nm (before adding the acid)
$A_{(after)\ 665\ nm}$	2nd absorbance measurement at 665 nm (after adding the acid)
$V_{Extract}$	Volume of the extract (in ml)
V_{Sample}	Volume of the aqueous sample (in ml)

Converted equation

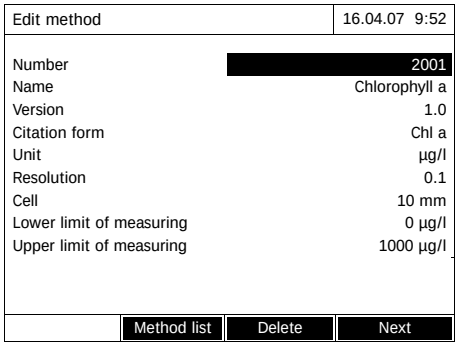
For entry on the photometer, assign names that you can enter in the formula editor on the photometer to the variables of the equation.

$$R = 29.6 * (A_{665nm} - A_{665nm\_2}) * (K_1/K_2)$$

with:

R (chlorophyll a (µg/l))	*Result (concentration chlorophyll A in µg/l)*
$A_{x\ nm}$ (= $A_{(before)\ 665\ nm}$)	*Variables for absorbance. These values are measured by the photometer. Here: Two measurements at the same wavelength, at different points of time.*
$A_{x\ nm\_2}$ (= $A_{(after)\ 665\ nm}$)	
K_1 (= $V_{Extract}$)	*Procedure variables*
K_2 (= V_{Sample})	*K1 = Volume of the extract (in ml)*
	K2 = Volume of the aqueous sample (in l)
Numerals	*Freely selectable numerical values*

<HOME>
Special / Multi wavelengths
– *[Setup]*
├ *Edit method*

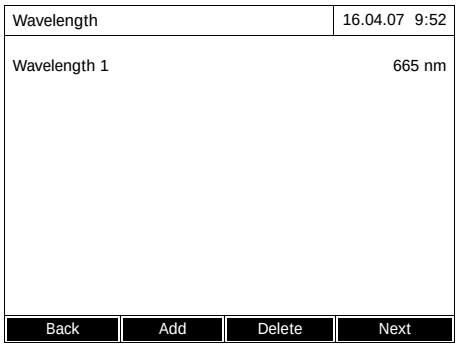


1 Enter the general method data here. The next available method number is already entered as the number.

You have the following options when filling out the input fields:

- Fill out all empty input fields one after the other
- Using *[Method list]*, select an already existing method as a model, give it a new method number and adjust the entries
- Using *[Method list]*, select an existing method in order to change it (without changing the number).
- You can delete the method completely with *[Delete]*.

2 Using *[Next]*, accept all entries on the page and switch to the next page.

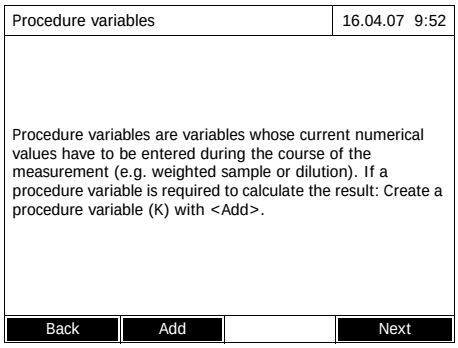


Enter the wavelengths for the absorbance measurements ($A_{x\ nm}$).

3 Add another wavelength with *[Add]*.

Delete a highlighted wavelength with *[Delete]*.

4 Using *[Next]*, accept all entries on the page and switch to the next page.

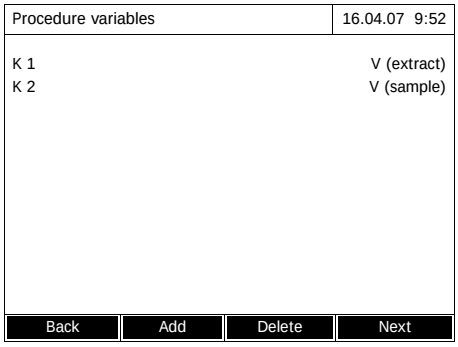


Create all required procedure variables.

5 Create a procedure variable required for the formula with *[Add]* and enter a designation, e.g. the measured parameter.

or

Using *[Next]*, accept all entries on the page and switch to the next page.

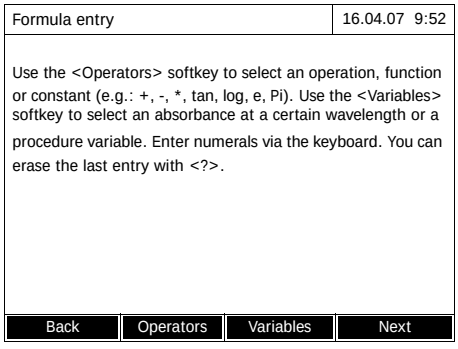


6 Add another procedure variable with *[Add]*.

or

Delete a highlighted procedure variable with *[Delete]*.

7 Using *[Next]*, accept all entries on the page and switch to the next page.



Enter the formula.

8 Enter any numbers with **<0...9>**.

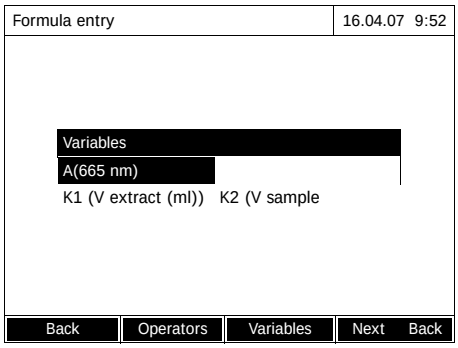
Use *[Operators]* , **<▲><▼> <◀><▶>** and **<START ENTER>** to enter an operator, a function or a constant.

Use *[Variables]*, **<▲><▼> <◀><▶>** and **<START ENTER>** to select a variable.

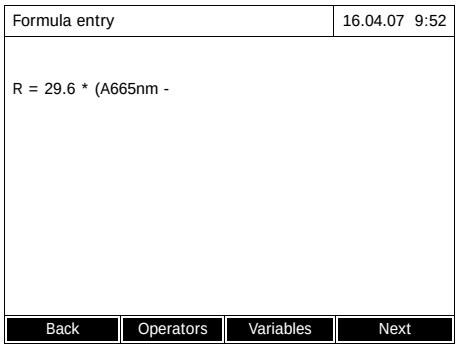
The formula is displayed after each step.

Using **<◀>** you can delete the last element of the formula.

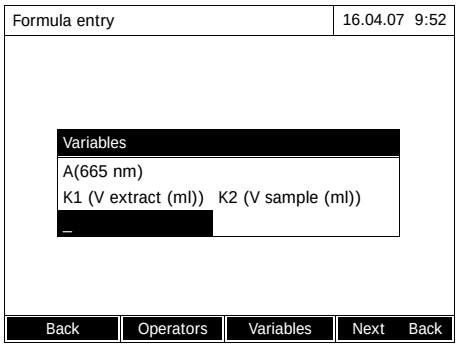
Use *[Back]* to quit the formula editor.



9 Select and confirm the variable.
The current version of the formula is displayed.

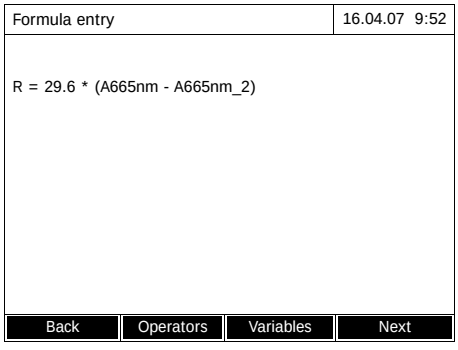


10 Add an operator.
The current version of the formula is displayed.

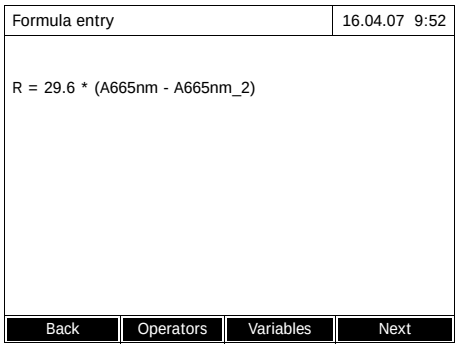


11 Select and confirm the Variable $A_{665\ nm}$ for the second measurement.
The current version of the formula is displayed.

12 To measure once again at the same wavelength:
Select the underscore (_).
The measurement input field pops up.
Enter the index for the measurement, e.g. 2 for the second measurement at this wavelength, and confirm.
The current version of the formula is displayed.

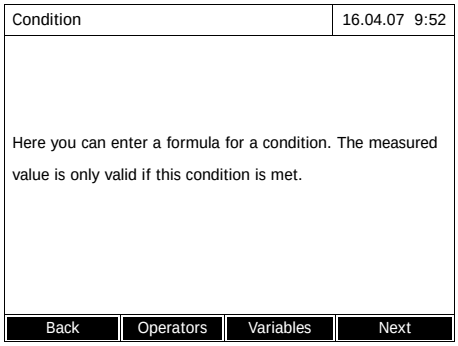


13 Complete the formula.
The current version of the formula is displayed.



14 Using *[Next]*, accept all entries on the page and switch to the next page.

If an error is in the formula, an error message appears.
The formula editor is only exited once the error is eliminated.



If necessary, enter the formula for a condition.

15 Enter any numbers with **<0...9>**.

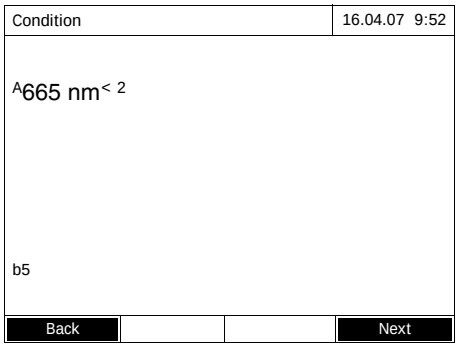
Use *[Operators]* , **<▲><▼> <◀><▶>** and **<START ENTER>** to enter an operator, a function or a constant.

Use *[Variables]*, **<▲><▼> <◀><▶>** and **<START ENTER>** to select a variable.

The condition is displayed after each step.

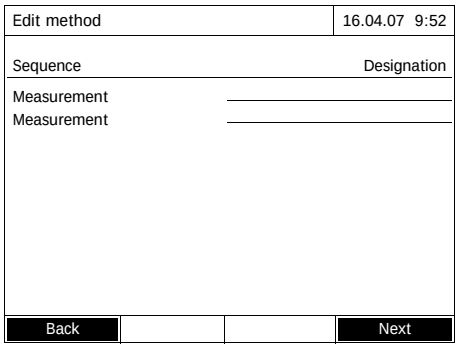
Using **<◀>** you can delete the last element of the condition.

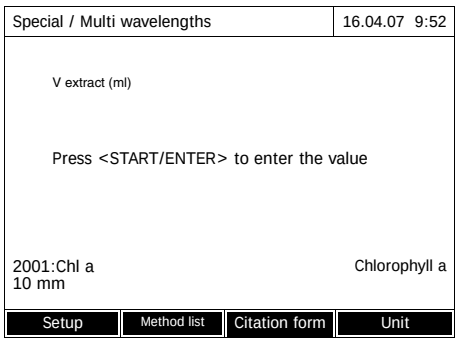
Use *[Back]* to quit the formula editor.



16 Complete the condition.

17 Complete the programming of the method with *[Next]*.





If the formula includes several measurements at the same wavelength (measurement sequence), you can assign names to the individual measurements of the sequence.

18 Enter the names for the individual measurements of a sequence.

19 Complete the programming of the method with *[Next]*.

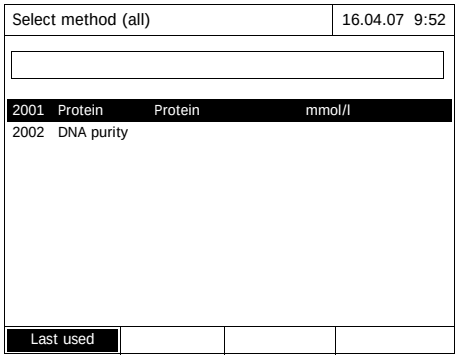
The method is programmed and selected.

The photometer is ready to measure.

4.7.3 Selecting a Special / Multi wavelengths method

To select a method for Special / Multi wavelengths measurements, proceed as follows:

<HOME>
Special / Multi wavelengths
[Method list]



The list of methods is displayed. The methods are ordered according to the method number.

Select the method:

1. Select the required method with **<▲><▼>**. The active selection is displayed in reverse video.
2. Accept the selection with **<START ENTER>**.

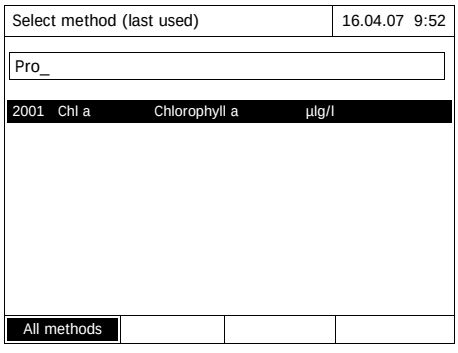
   The photometer is ready to measure.

Narrowing down the method list

If the list is very long, you can narrow down the method list and thus make the search easier as follows:

- Using *[Last used]*, you can restrict the method list to the ten methods last used.
- With the search function you can search certain character strings in the list. The search takes place as a full-text search of the entire list contents. Thus you can search for a method number or certain citation form.

Search function



Search for a character string:

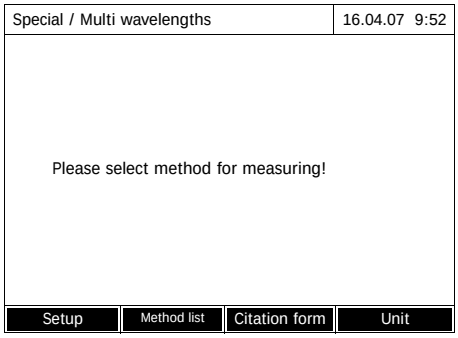
Enter the character string to be searched for in the search window with **<A...9>**.

The list appearing below shows all hits containing the character string. The hit list is updated with each character that is entered.

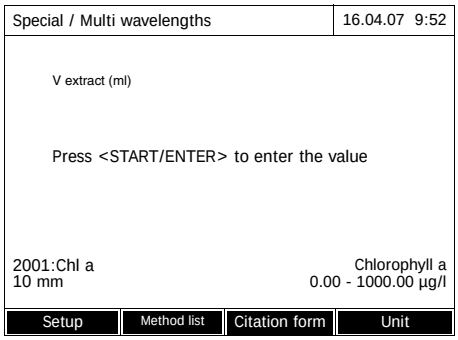
Note
Note the case sensitivity when searching.

4.7.4 Carrying out Special / Multi wavelengths measurements

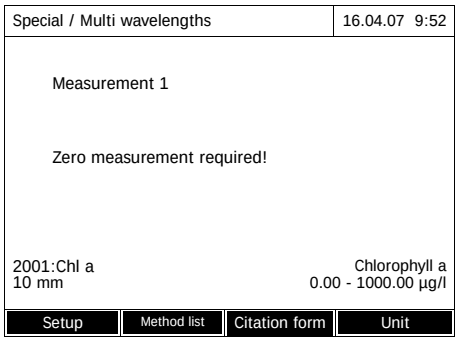
<HOME>
Special / Multi wavelengths



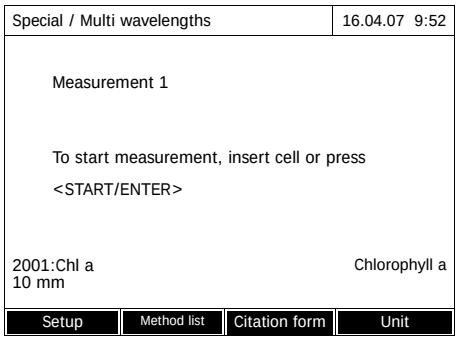
1 Select the required method with *[Method list]* (see section 4.7.3).



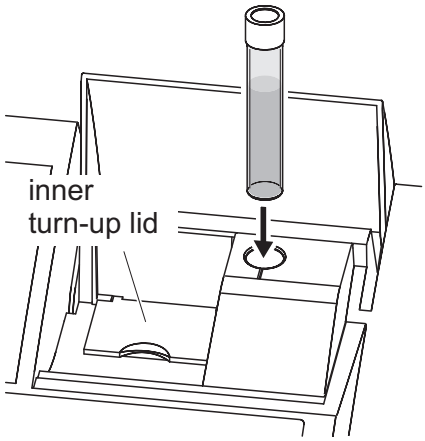
For methods with procedure variables: Enter the values of all procedure variables one after the other.



If necessary, carry out a zero measurement.



The photometer is ready to measure.

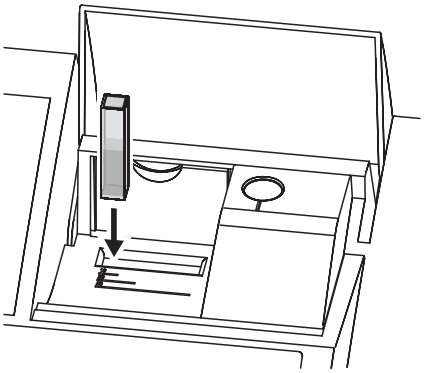


2 Depending on the type, insert the cell as follows:

Round cell:

Insert the round cell in the round cell shaft so it touches the bottom.

If the inner turn-up lid is opened too wide, a message prompts you to close the inner turn-up lid.

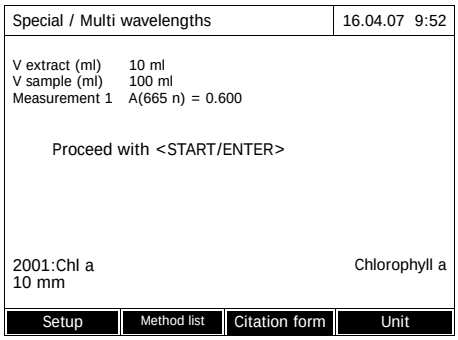


Rectangular cell:

Open the inner turn-up lid.

Insert the rectangular cell vertically so it touches the bottom and left edge of the cell shaft. The opaque sides of the rectangular cell must point to the front and back.

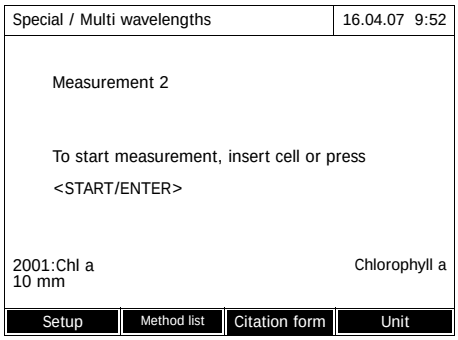
The photometer has an external light recognition. If there is too much external light, a message prompts you to close the cell shaft cover.



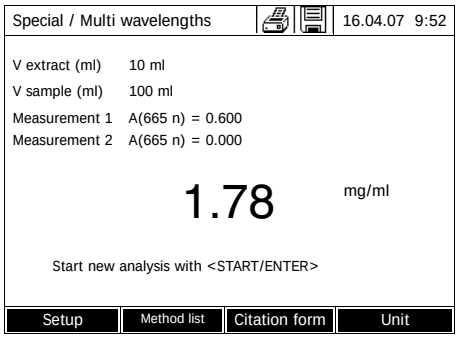
An intermediary result is displayed if there are several measurements.

The photometer is ready for the next measurement.

3 Start the measurement.



The photometer is ready to measure.



The result is displayed.

If an entered condition is not met, no measured value is displayed.

4 If necessary, start a new measurement with the method.

4.8 Spectrum

4.8.1 General information

With the Spectrum function, the absorbance or *Transmission* in dependency of the wavelength is measured and recorded. The wavelength range can be freely selected within the measuring range of the photometer. The increment is 1 nm.

A spectrum is recorded without using any methods or profiles. All settings are configured during measurement.

Baseline

A baseline has to be recorded before a spectrum is recorded. The baseline has to cover at least the wavelength range of the spectrum to be recorded. Once the baseline is measured, it remains stored in the photometer until

- a new baseline is recorded
- the *Spectrum* mode is exited or the photometer is switched off

Settings

You can record a spectrum with standard settings without opening the setting window.
The following settings are possible for a spectrum:

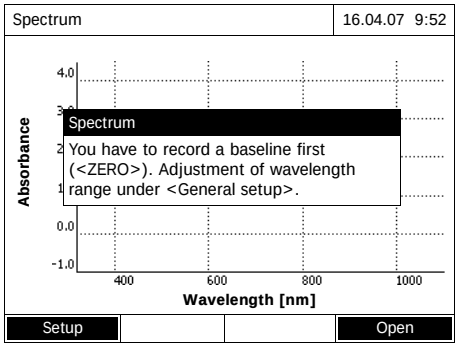
Input field	Possible entries
Wavelength start	190* ... 1100 nm
Wavelength stop	190 ... 1100* nm
Mode	*Absorbance** or *Transmission*
Smoothing	*Yes** or *No*
Scaling	*Auto** or *Manual*
Scaling: *Auto**	During measurement, the instrument adjusts the axis scaling (minimum and maximum value of the axis) to the measured values. The entire curve is always visible.
Scaling:*Manual* *Y-axis min* *Y-axis max*	The axis scaling (minimum and maximum value of the axis) is set manually.

* default setting

Note
You can store the current settings as a profile with *[Save]*.
You can load a stored profile with *[Open]*.
Profiles for spectra have the file extension, ".profil".

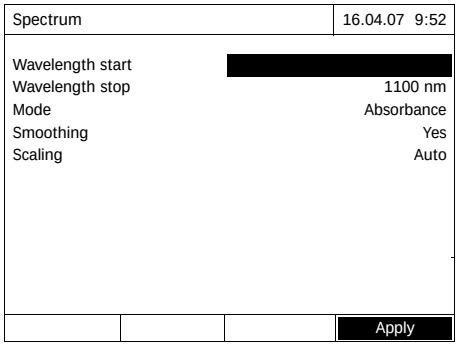
4.8.2 Recording the Spectrum

<HOME>
Spectrum



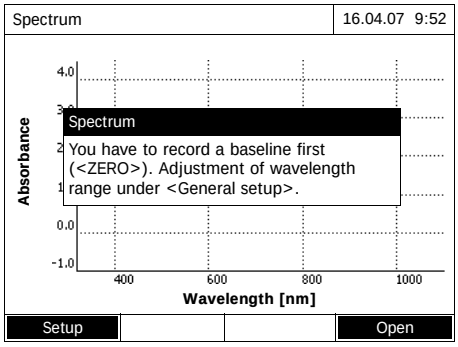
A message containing operating instructions is displayed.

1 Open the setting menu with *[Setup]*.

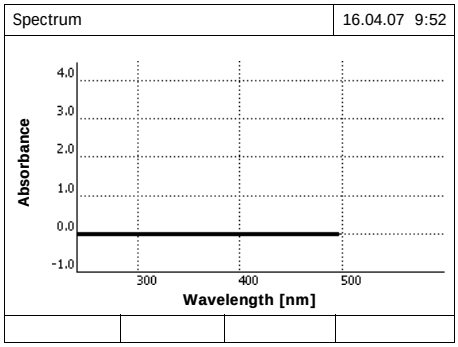


2 Select the start and end point of the spectrum to be recorded and the mode (*Absorbance* or *Transmission*).

3 Accept all entries with *[Apply]*.



A message containing operating instructions is displayed.

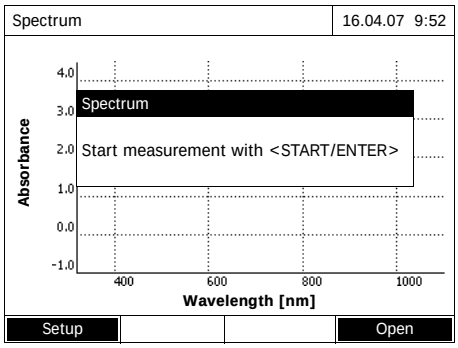


<u>Recording the baseline:</u>

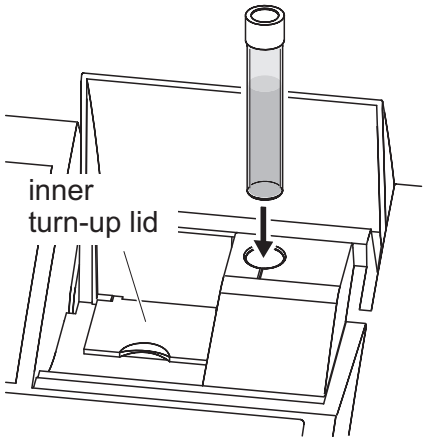
4 Press the **<BLANK ZERO>** key.

The photometer records the baseline.

5 Wait until the baseline is completely recorded.



The photometer is ready to measure after the baseline has been recorded.



Recording the spectrum:

6 Depending on the type, insert the cell as follows:

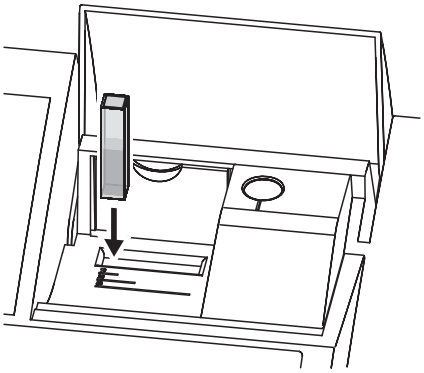
Round cell:

Insert the round cell in the round cell shaft so it touches the bottom.

7 Close the inner turn-up lid.

8 Start the measurement with **<START ENTER>**.

After the spectrum has been recorded, the following message appears: *Recording of spectrum is completed.*



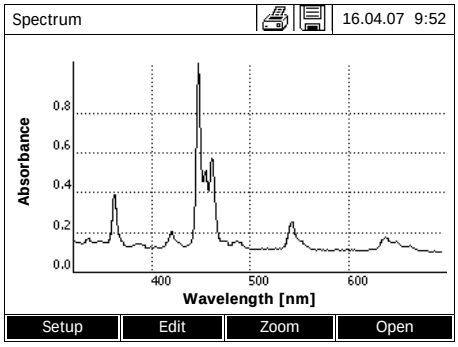
Rectangular cell:

Open the inner turn-up lid.

Insert the rectangular cell vertically so it touches the bottom and left edge of the cell shaft. The opaque sides of the rectangular cell must point to the front and back.

9 Close the cell shaft cover.

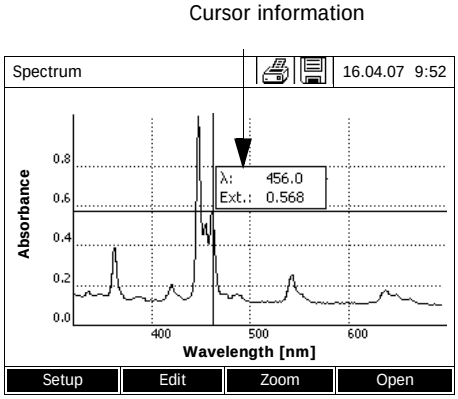
10 Start the measurement with **<START ENTER>**.



11 Wait until the spectrum is completely recorded.

At the end of the recording the following message appears: *Recording of spectrum is completed.*

12 Confirm the message with **<START ENTER>**.



The cursor appears at the absolute maximum of the spectrum.

13 You have the following options:

- Immediately edit the spectrum (see section 4.8.3)
- With **<PRINT>**, you can output the spectrum to a connected printer as a graphic.
- You can save the spectrum as a *.csv file with **<STORE>**. As the storage location, you can select the photometer (*Internal DataB folder*) or a USB memory device connected to the USB-A connection (*USB memory*). Stored spectra can be recalled and edited at any time (see section 4.8.3).

4.8.3 Loading/editing a spectrum

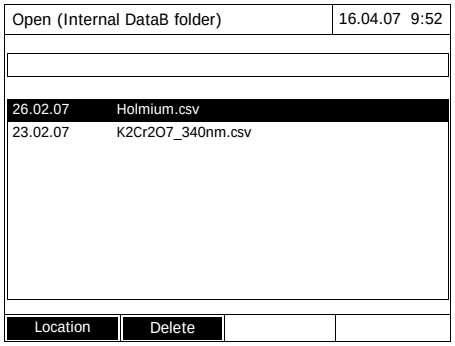
A spectrum can be edited immediately after measurement. Stored spectra can be loaded and edited as well.

The following tools are available for editing:

- Cursor function for incremental moving along the curve with indication of the x and y values
- Zoom function to scale up a section
- Mathematical functions for various evaluating and calculating operations. The functions are described from page 100.

Loading a stored spectrum

<HOME>
Spectrum
– *[Open]*



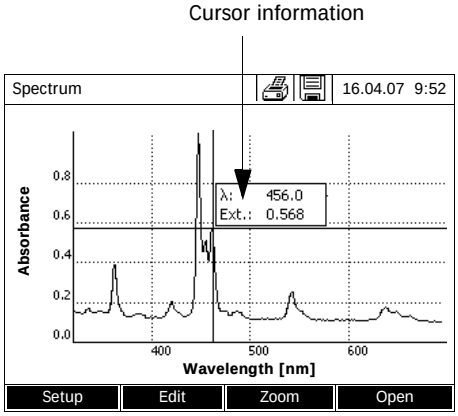
The list with the spectra stored in the exchange memory is displayed.

1 If necessary, you can select a different memory location for the spectrum with *[Location]* (USB memory device at the USB-A connection).

2 Select the required spectrum.

The original view of the curve is displayed.

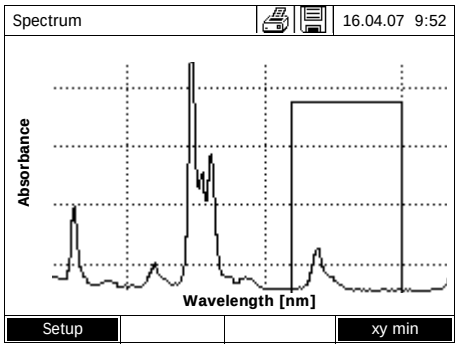
Cursor



The cursor consists of a horizontal and vertical line that cross each other on a point of the curve. A box names the x and y values of the point of the curve.

Move the cursor along the x axis (wavelength) with **<◀><▶>**. You can scan and evaluate the curve point after point.

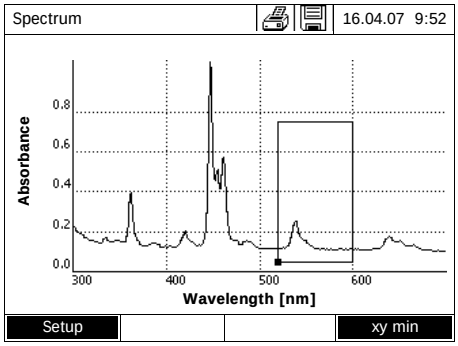
Zoom



1 Press *[Zoom]*.

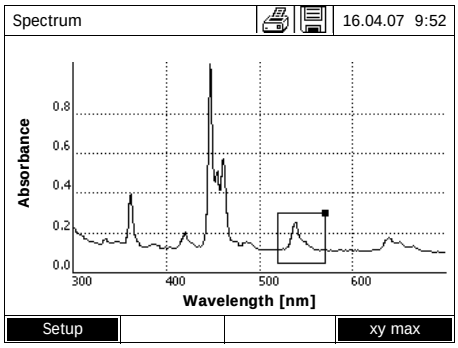
The zoom window appears. The bottom left corner of the zoom window is marked by a small black square.

– You can return to the original view of the spectrum with *[Original]* at any time.



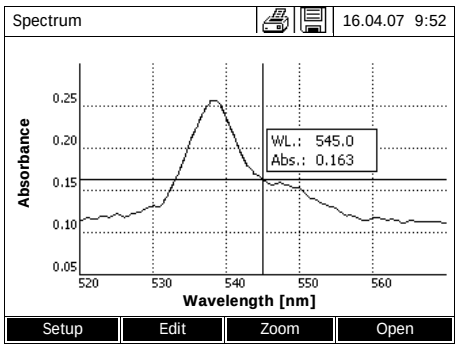
2 Adjusting the zoom window:

– Define the bottom left corner of the zoom window with **<◀><▶>** and **<▲><▼>**.



– Use *[*xy max*]* to mark the top right corner of the zoom window (small black square).

– Define the top right corner of the zoom window with **<◀><▶>** and **<▲><▼>**.



3 Scaling up the zoom window:

– Press the **<START ENTER>** key. The zoom window is scaled up on the entire diagram area.

<u>Leaving the zoom view:</u>

– You can return to the original view of the spectrum with **<ESC>** at any time.

Edit Open the selection of mathematical functions with *[Edit]*:

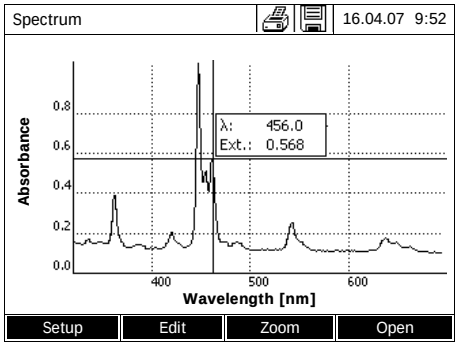
- *Extreme values (zoomed area)*
  Highlights the extreme values (minimum and maximum values) of the displayed spectrum.
- *Mark points*
  Opens an edit mode where you can highlight individual points of the spectrum.
  With the *[Mark]* function key you can highlight individual points.
  The wavelength and measured valued are displayed at the highlighted point.
  With the *[Delete]* function key you can remove individual points.
- *Delete all marks*
  Erases all highlighted points in the spectrum.
- *Original*
  Displays the original, unedited spectrum.
- *Integral*
  Calculates the area between the zero line and curve within a freely selectable wavelength interval [X1,X2].
- *Derivative*
  Calculates the derivative of the total spectrum. To calculate the second and third derivative, the function can be carried out several times.
- *Compare spectrum*
  Loads a second spectrum into the same diagram for direct comparison.
- *Add spectrum*
  Adds a stored spectrum to the current spectrum.
- *Subtract spectrum*
  Subtracts a stored spectrum from the current spectrum.
- *Divide spectrum (ratio)*
  Divides the absorbance or % transmission values of the current spectrum by the values of a stored spectrum
- *Add fixed value*
  Adds a constant absorbance or % transmission value to the current spectrum.
- *Multiply fixed value*
  Multiplies the absorbance or % transmission values of the current spectrum by a constant value.

Note
The addition, subtraction and division of two spectra always applies to the common wavelength range of both spectra only.

4.8.4 Saving / exporting a spectrum

The saving of a spectrum saves both the edited and the original spectrum. Consequently, the original spectrum can be restored from each stored spectrum.

Saving



1. Record a spectrum (see section 4.8.2)
   or
   Load a stored spectrum (see section 4.8.3).
2. If necessary, connect a USB memory device to the USB-A interface.
3. Open the save dialog with **<STORE>**.
4. If necessary, change the storage location with *[Location]*:
   Internal DataB folder:
   Exchange folder in the instrument
   or
   USB memory:
   USB memory device connected at the USB-A connection.
5. If necessary, change the file name.
6. Save the file with **<START ENTER>**.

Export to a PC Export a stored spectrum to a PC: see section 4.12.3

4.9 Kinetics

The Kinetics function enables the temporal tracing of the absorbance or transmission of a sample at a certain wavelength.

The photometer automatically calculates the slope between two adjacent measuring points from the available measurement data.
The catalytic activity can also be determined and displayed if required.

To record the kinetics, the photometer carries out single measurements at regular intervals (measuring interval) and stores the measured values as a time function.

All settings for a recording are administrated as a profile. Profiles can be created, stored, edited and deleted. Each measurement requires a respective profile.

4.9.1 Creating/editing profiles for Kinetics recordings

Note
Profiles for Kinetics records are stored under the numbers 4001 to 4020.
In the delivery condition, a profile is stored for demonstration purposes.

A profile for a Kinetics recording comprises the following data:

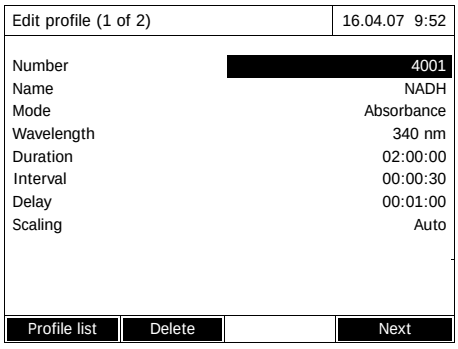
Input field	Possible entries
Number *	4001 ... 4020
Name	Any name (max. 18 characters)
*Mode**	*Absorbance* or *Transmission*
*Wavelength**	Freely selectable (in nm)
*Duration**	Total duration in the format hh:mm:ss (hours:minutes:seconds)
*Interval**	Measuring interval = time interval between two successive single measurements in the format hh:mm:ss (hours:minutes:seconds) Exception: With the setting, *Measurements/interval*: *Max/ interval* the interval is defined differently (see below).
Delay	Time between the start of the recording and the start of the first single measurement
Scaling	*Auto* or *Manual*

Input field	Possible entries
Scaling: *Auto***	During measurement, the instrument adjusts the axis scaling (minimum and maximum value of the axis) to the measured values. The entire curve is always visible.
Scaling:*Manual* *Y-axis min* *Y-axis max*	The axis scaling (minimum and maximum value of the axis) is set manually.
Measurements/interval	*1/interval* or *Max/interval* Here you define how many measurements are carried out per interval. This setting has an impact on the calculation of the slope of the individual intervals (see section 4.9.6).
Catalytic activity	*Yes* or *No* Here you determine whether the catalytic activity should be calculated. The catalytic activity is a measure for the amount of substance that is converted per time unit. To accelerate the substance conversion, a catalyst or enzyme (biological catalyst) is used in most cases.
Catalytic activity:*Yes* *Factor* *Unit* *Resolution*	The catalytic activity or enzymatic activity is calculated from the slope of the curve. Cat. A. = mean value *Slope [Δ/min]* * *Factor* Here you can enter the value for *Factor*. The calculated value for the catalytic activity is displayed in the menu, *[Edit]* / *Slope & catalytic activity*, together with the unit and resolution selected here.

* necessary inputs
** default: *Auto*

Creating/editing a profile

<HOME>
Kinetics
– *[Setup]*
├– *Edit profile*

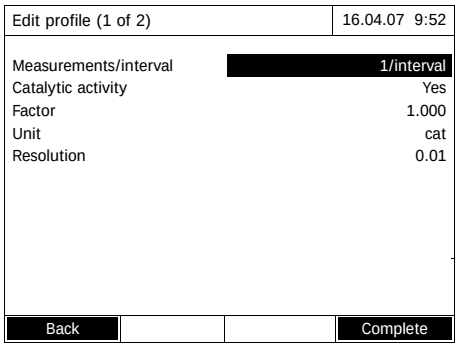


1 Enter the data for the profile here. The next available profile number is already entered as the number.

You have the following options when filling out the input fields:

- Fill out all empty input fields one after the other
- Using *[Profile list]*, select an already existing profile as a model, give it a new profile number and adjust the entries
- Using *[Profile list]*, select an existing profile in order to change it (without changing the number).
- You can delete the profile completely with *[Delete]*.

2 With *[Next]* you can switch to further settings.



3 Enter further data for the profile here.

4 Accept all entries with *[Complete]*.

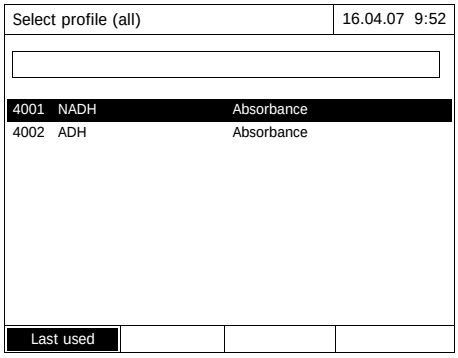
The profile is created and selected. The photometer is ready to measure.

Note
The *Catalytic activity* function is only available if the Absorbance mode was selected.

4.9.2 Loading a profile for Kinetics recording

To load a profile for Kinetics recording, proceed as follows:

<HOME>
Kinetics
├ *[Profile list]*



The list of profiles is displayed. The profiles are ordered according to the profile number.

Selecting a profile:

1 Select the required profile with **<▲><▼>**. The active selection is displayed in reverse video.

2 Accept the selection with **<START ENTER>**.

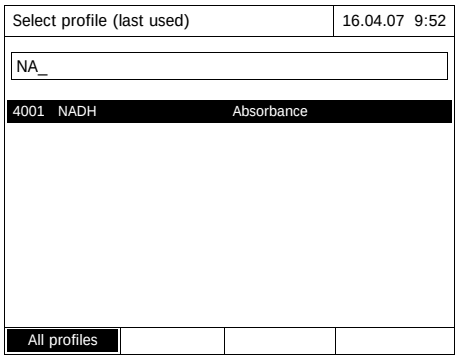
The photometer is ready to measure.

Narrowing down the list of profiles

If the list is very long, you can narrow down the profile list and thus make the search easier as follows:

- Using *[Last used]*, you can restrict the profile list to the ten profiles last used.
- With the search function you can search certain character strings in the list. The search takes place as a full-text search of the entire list contents. Thus you can search for a profile number or name.

Search function



Search for a character string:

Enter the character string to be searched for in the search window with **<A...9>**.

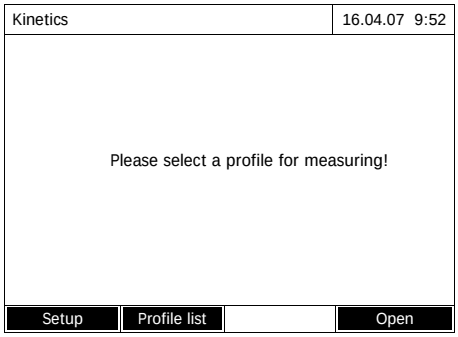
The list appearing below shows all hits containing the character string. The hit list is updated with each character that is entered.

Note
Note the case sensitivity when searching.

4.9.3 Recording the Kinetics

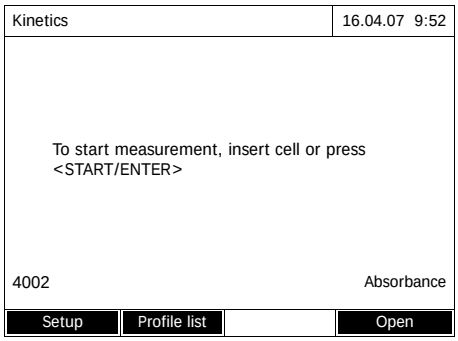
Note
During the recording, the photometer cannot carry out any regular self-test or self-calibration (AutoCheck), because the recording would have to be interrupted for this. A warm-up time of at least two hours is required for the photometer to measure reliably during the recording.

<HOME>
Kinetics

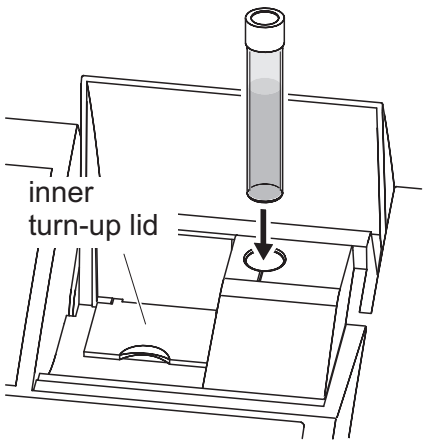


Note the warm-up time of at least 2 hours for kinetic recordings.

1 Select the required profile with *[Profile list]* (see section 4.9.2).



The photometer is ready to measure after the profile has been selected.

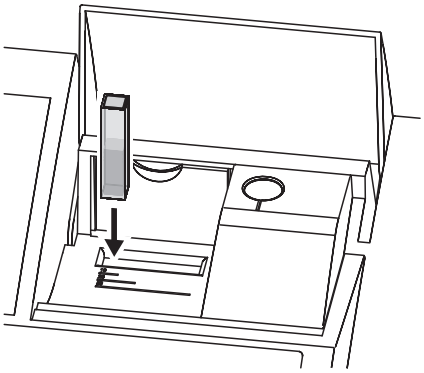


2 Depending on the type, insert the cell as follows:

Round cell:

Insert the round cell in the round cell shaft so it touches the bottom.

If the inner turn-up lid is opened too wide, a message prompts you to close the inner turn-up lid.



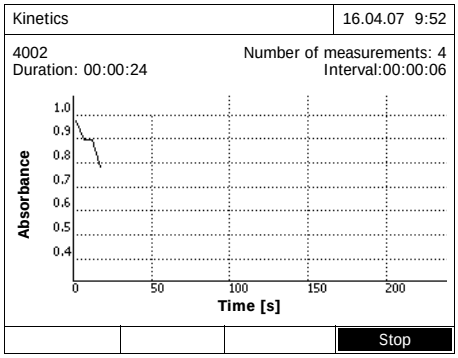
Rectangular cell:

Open the inner turn-up lid.

Insert the rectangular cell vertically so it touches the bottom and left edge of the cell shaft. The opaque sides of the rectangular cell must point to the front and back.

The photometer has an external light recognition. If there is too much external light, a message prompts you to close the cell shaft cover.

The photometer starts recording automatically.

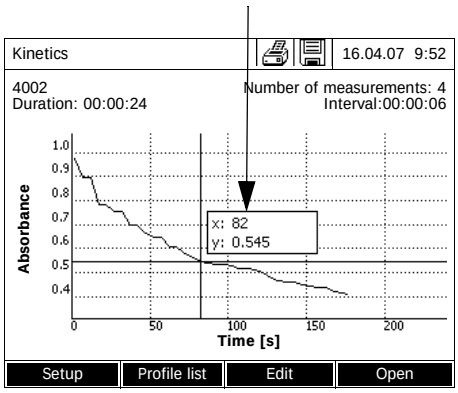


3 Wait until the recording is finished.

Stopping the recording:

- Use *[Stop]* to terminate the recording prematurely. The curve recorded up to this point can be stored and edited (see section 4.9.6).
- Use **<ESC>** to completely cancel measurement. The curve recorded up to this point is discarded.

Cursor information



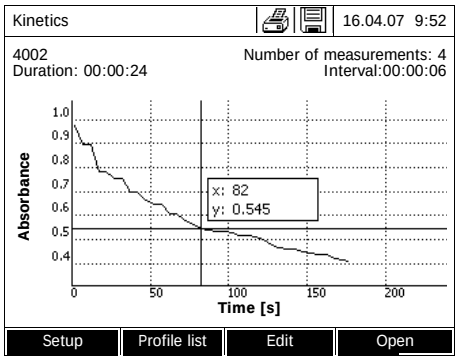
4 After the specified *Duration* has expired, the cursor appears.

You have the following options:

- You can move the cursor along the curve and have the measurement data for each point displayed (see section 4.9.6)
- With **<PRINT>**, you can output the kinetic curve to a connected printer as a graphic.
- You can store the kinetic curve with **<STORE>** (see section 4.9.4).
- Execute further functions to edit the kinetic record (see section 4.9.6)
- Close the kinetic record with **<ESC>**.

4.9.4 Saving / exporting a Kinetics record

Saving



1. Carry out the kinetic recording (see section 4.9.3)
   or
   Load a stored kinetic record (see section 4.9.4).
2. If necessary, connect a USB memory device to the USB-A interface.
3. Open the save dialog with **<STORE>**.
4. If necessary, change the storage location with *[Location]*:
   Internal DataB folder:
   Exchange folder in the instrument
   or
   USB memory:
   USB memory device connected at the USB-A connection.
5. If necessary, change the file name.
6. Save the file with **<START ENTER>**.

Export to a PC Export a stored kinetic record to a PC: see section 4.12.3

Example of a kinetic recording (*.csv file)

```
6|4001|1|1|525|1280913092|59|5|1|0.000|0.301|0|1.000|µkat|2

Device: Serial number:Software:             User:
Pharo 300 09130512 1.30-Merck-1.60          Administrator

Start time          Wavelength [nm]
04.08.2010 11:11    525

Time [s]            Absorbance
0                   0,092
5                   0,077
10                  0,073
15                  0,069
..                  .....
```

Line 1 - explanations:

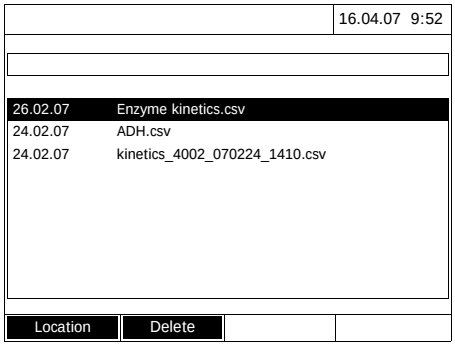
Column	Value	Explanation
1	6	Version of the file format for the CSV file
2	4001	Profile number
3	1	Measurement of absorbance (0) or transmission (1)
4	1	Measurement once per interval (0) or as often as possible (1)
5	525	Wavelength (in nm)
6	1280913092	Start time (internal data format)
7	59	Duration (in sec)
8	5	Interval time (in sec)
9	1	Scaling automatic (0) or manual (1)
10	0.000	Minimum for manual scaling
11	0.301	Maximum for manual scaling
12	0	Enzymatic activity Off (0) or On (1)
13	1.000	Factor for enzymatic activity
14	µkat	Unit of enzymatic activity
15	2	Decimal points for enzymatic activity

4.9.5 Loading a Kinetics record

You can load and view stored Kinetics records.

Loading a stored Kinetics record

<HOME>
Kinetics
– *[Open]*



The list with the stored Kinetics records is displayed (*Internal DataB folder*).

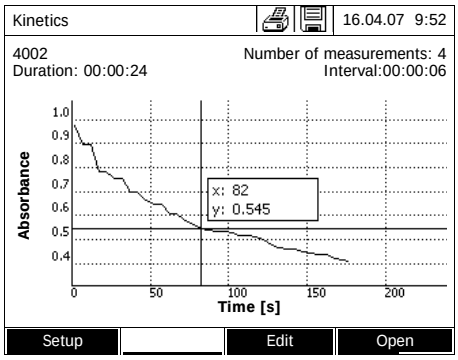
1 With *[Location]* select the memory location of the kinetic record (*Internal DataB folder* or *USB memory* for a USB memory device at the USB-A connection).

2 Select the required Kinetics record.

The curve is loaded.

You have the following options:

- You can move the cursor along the curve and have the measurement data for each point displayed (see section 4.9.6)
- With **<PRINT>**, you can output the kinetic curve to a connected printer as a graphic.
- You can store the kinetic curve with **<STORE>** (see section 4.9.4).
- Execute further functions to edit the kinetic record (see section 4.9.6)
- Close the kinetic record with **<ESC>**.



4.9.6 Editing a Kinetics record

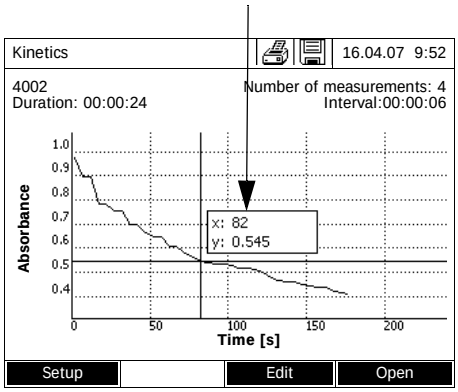
The following functions are available for kinetic records:

- Moving along the curve with the cursor
- Displaying a list with the slopes of the curve for each interval
- Scaling the Y-axis of the diagram

- Combined display of two kinetic records in one graphic
- Display of the difference of two kinetic records

Cursor

Cursor information



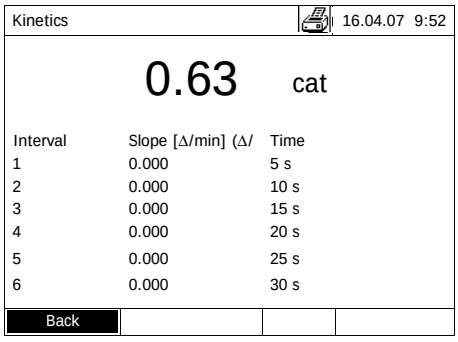
The cursor consists of a horizontal and vertical line that cross each other on a point of the curve. A box names the x and y values of the point of the curve.

Move the cursor along the x axis (time axis) with **<◀><▶>**. You can scan and evaluate the curve point after point.

Slope of the curve & catalytic activity

The function, *Slope & catalytic activity* indicates the slope of the kinetic curve in the individual intercepts (intervals) of the curve.
An intercept corresponds to the *Interval* entered in the profile.

1 Indicate the slope of the kinetic curve in the individual intercepts (intervals) of the curve with *[Edit]* / *Slope & catalytic activity*.



If the calculation of the catalytic activity was selected when the profile was created it is displayed here together with the slope.

Note
The *Slope & catalytic activity* function is only available if the kinetic recording was done in the Absorbance mode.

The displayed slope for an interval is determined as follows, depending on the slope:

Measurements/interval	Slope
1/interval	Slope, converted to the interval, "1 minute"
Max/interval	Slope of the straight line determined by linear regression in an interval, converted to the interval, "1 minute"

Scaling of the Y-axis

You can manually determine the scaling of the Y-axis with *[Setup]*/*Scaling*/*Manual*.

Compare kinetics

For direct comparison, you can load a second kinetic record into the same diagram with *[Edit]* / *Compare kinetics*.

Note
The *Compare kinetics* function can only be carried out if both kinetic records were made in the Absorbance mode.

Subtract kinetics

You can subtract a stored kinetic record from the current kinetic record with *[Edit]* / *Subtract kinetics*.

Note
The *Subtract kinetics* can only be carried out if both kinetic records were made with the following settings:

- Mode: Absorbance
- Measurements/interval:1/interval
- Equal interval

4.10 Timer

You can use the timers to remind you by an acoustic signal of a time interval that has expired.

The photometer has two types of timers:

- The *User defined timer* is a timer that can be freely assigned. The interval and name can be freely set. Only one freely assignable timer is available. It cannot be erased (see section 4.10.1).
- *Analysis timer* are timers permanently stored in the photometer. The names and intervals of the analysis timers are stored in the method data of a measuring method (*Concentration* mode). The number of available analysis timers corresponds to the number of reaction times prescribed in the analysis instructions of the programmed methods (see section 4.10.2).

The photometer administrates all timers in the timer overview.

The timer overview (the *Timer* menu) is opened with the **<TIMER>** key. The *Timer* menu can be opened in any operating situation.
Operation of the timer does not disturb any other functions.
The timer overview can be exited with the **<ESC>** key.

When the *Timer* menu is opened for the first time, only the user-defined timer is in the timer overview. You can include analysis timers into the list or remove them according to your requirements (see section 4.10.2).

The timer overview displays the status of each timer and, of a started timer, the remaining time of the specified time interval.

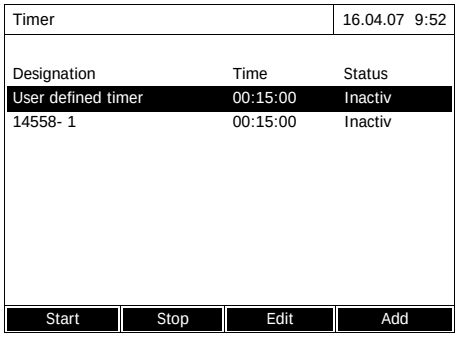
All timers are started manually.
As soon as one single timer has been started the timer symbol appears on the display in all operating modes.

When a timer has been started it is given the timer status, *Active*.
When the specified time interval has expired the timer status changes from *Active* to *Expired* and an acoustic signal sounds.
In the timer status *Expired* the acoustic signal sounds until the timer is stopped manually.
After the stop, the timer status changes to *Inactive* and the acoustic signal is switched off.

4.10.1 *User defined timer*

If you want to manually enter time intervals, use the *User defined timer* function.

<TIMER>



The *Timer* menu is open.

1 Highlight the *User defined timer*.

2 If necessary, change the name and time of the timer with *[Edit]*.

3 Start the highlighted timer with *[Start]*.

The status of the timer is *Active*. When the specified time interval has expired, an acoustic signal sounds and the status changes to *Expired*.

4 Stop the highlighted timer with *[Stop]*.

The status of the timer changes to *Inactive*. The acoustic signal is switched off.

4.10.2 Analysis timer

Between the individual steps of a measurement, reaction times often have to be observed. The length of the reaction time is defined in the relevant analysis instructions.

For all required reaction times, the analysis timers with the corresponding time intervals are stored in the instrument. The names of the analysis timers include the method name and a current number so several timers within a method can be distinguished from each other.

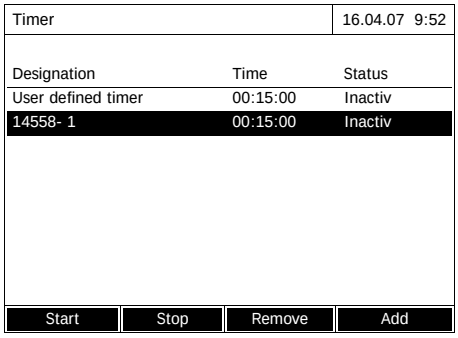
To be able to use an analysis timer for a method you have to load it first in the timer overview.
To do so, first select the required method and then add the available analysis timers to the timer overview so they can be started as necessary.
The timer overview always comprises the free timer and the selected analysis timers.

1 Select the required method in the *Concentration* mode.

Manual selection of the method (see section 4.5.5).

2 Open the Timer menu.

<TIMER>



The *Timer* menu is open.

3 If necessary, add a new timer to the list with *[Add]*.

Note:
The *[Add]* function key is only displayed if a method is selected for which analysis timers were programmed but are not yet displayed in the list of timers.

4 Highlight an analysis timer.

5 If necessary, remove the analysis timer from the list with *[Remove]*.

6 Start the highlighted timer with *[Start]*.

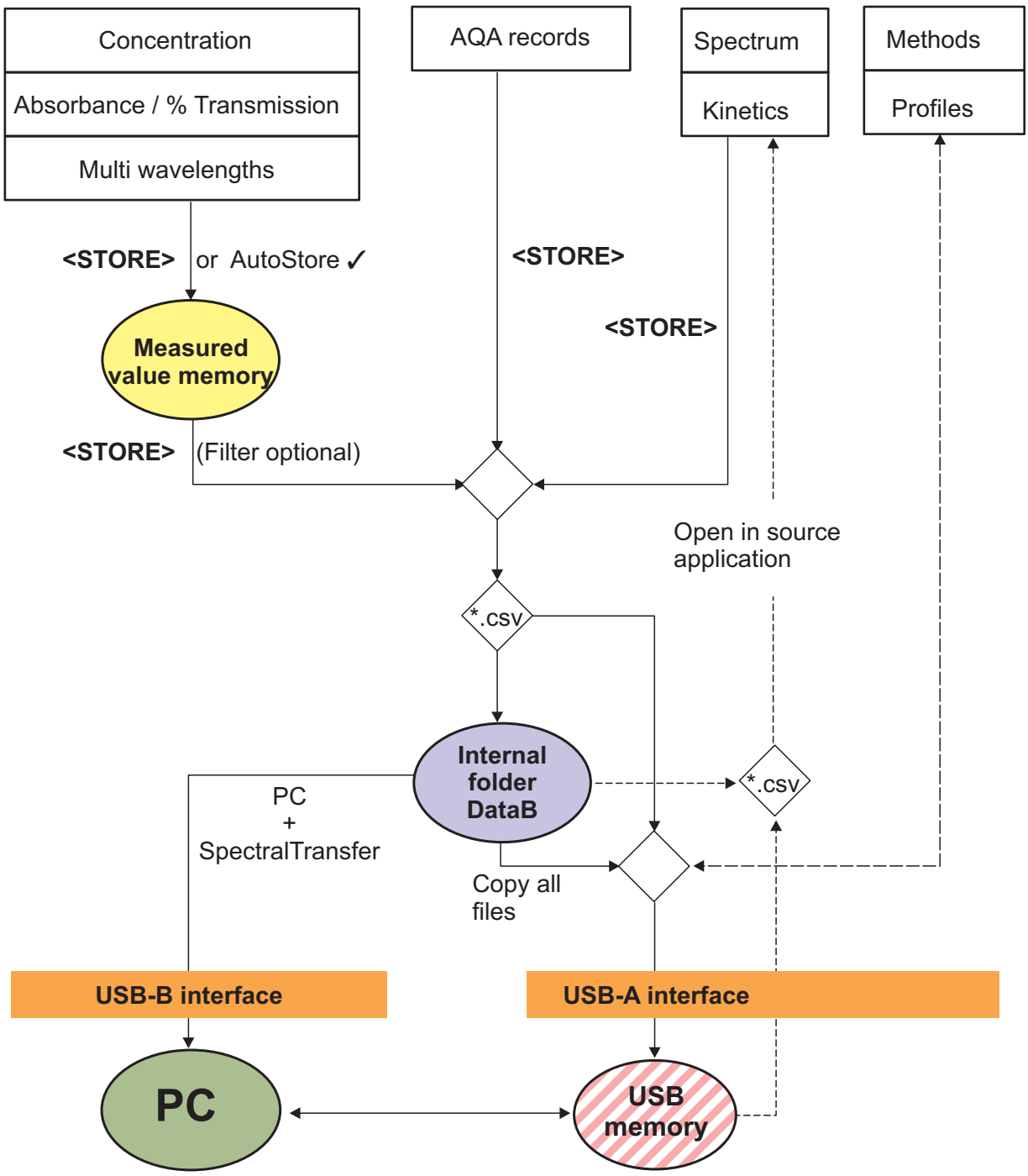
The status of the timer is *Active*. When the specified time interval has expired, an acoustic signal sounds and the status changes to *Expired*.

7 Stop the highlighted timer with *[Stop]*.

The status of the timer changes to *Inactive*. The acoustic signal is switched off.

4.11 Memory

4.11.1 Overview



Measurement data	Save, back up, export
Concentration, *Absorbance / % Transmission* *Special / Multi wavelengths*	Measurement datasets of these measuring modes are first stored in the measured value memory of the photometer (1000 memory locations) with **<STORE>** or *AutoStore*. The measured value memory is available from the *Measurement data memory* menu. Here you can view, filter and export into a PC-readable file (*.csv) the stored measurement datasets (**<STORE>**). Csv files of these measuring modes cannot be reimported to the photometer. Measurement datasets of these measuring modes can also be stored to a pdf file (see section 4.11.11).
Spectrum *Kinetics*	You can store and export measurement data of these measuring modes directly as a PC-readable file (*.csv) with **<STORE>**. Csv files of these measuring modes can be reimported and displayed on the photometer. Measurement data of these measuring modes can also be stored to a pdf file (see section 4.11.11).
AQA records	You can store and export measurement data of these measuring modes directly as a PC-readable file (*.csv) with **<STORE>**. Csv files of records cannot be reimported to the photometer. Measurement data of these measuring modes can also be stored to a pdf file (see section 4.11.11).
User-defined methods / profiles	Method data and profile data are stored and exported with the *Exchange methods/profiles* function in the **<HOME>**/*General setup* menu.

For each export procedure you can select the location where the PC-readable files (*.csv, *.pdf) should be stored: either to the photometer (*Internal DataB folder*) or an external memory (*USB memory*). On an external memory, the data are stored in the pHotoLab_6600 directory.

The files stored in the photometer (*Internal DataB folder*) can later be transferred to a connected PC or to an external memory (*USB memory*).

4.11.2 Instructions on using USB memory devices

The safety of data stored on USB memory devices depends on the quality of the memory device and the data transmission.
Data is stored partly or not at all if for example:

- The power supply of the external memory device is interrupted during the write process, or
- The external memory device is prematurely disconnected from the photometer during the data backup.

To prevent a data loss we recommend the following:

- Save all data internally in the photometer first.
- After performing a backup leave the USB memory device connected to the photometer for some time.
- Check whether the stored data is complete, e.g. on a PC.
- Use the USB memory device for data transport but not for permanent data storage.

4.11.3 Measurement datasets

Elements of a measurement dataset

A complete measurement dataset consists of:

- Consecutive number (is automatically assigned by the photometer)
- Date/time
- Identification (e.g. ID or "AutoStore")
- User name
- Measured parameter, e.g. method number, dilution, wavelength (depending on the measuring mode)
- Measured value with unit and, if necessary, citation form

Operations with measurement datasets

Measurement datasets can be

- stored (see section 4.11.4)
- displayed and printed (see section 4.11.6)
- filtered, i.e. selected or hidden based on certain criteria (see section 4.11.7 and section 4.11.8)
- deleted (see section 4.11.9).

If the storage is full

You can erase measurement datasets (see section 4.11.9), or overwrite the oldest dataset with the next storing procedure. A security prompt appears before a dataset is overwritten. To backup the measurement data, you can transmit the measurement datasets from the measurement data memory to the internal DataB folder or a USB memory device connected to the USB-A connection and archive them further from there (see section 4.12.3).

4.11.4 Saving measurement datasets manually

After each measurement, you can store the measurement data manually with the **<STORE>** key. It is stored in the measurement data memory. The memory symbol in the header indicates that the measurement data displayed on the screen is ready to be stored. With the measuring modes, *Concentration*, *Absorbance / % Transmission*, and *Special / Multi wavelengths* you have the additional option to automatically store all new measured values at the time of the measurement (*AutoStore*, see section 4.11.5).

Storing with identification (ID)

When storing manually, an input field for the identification (ID) appears after pressing the **<STORE>** key. Here you can enter an individual combination of alphanumeric characters for later easier identification of the measurement datasets. 30 digits are available for this.

The following measurement data are stored in the measured value memory

automatically (see section 4.11.5) or manually (with the **<STORE>** key, see section 4.11.4):

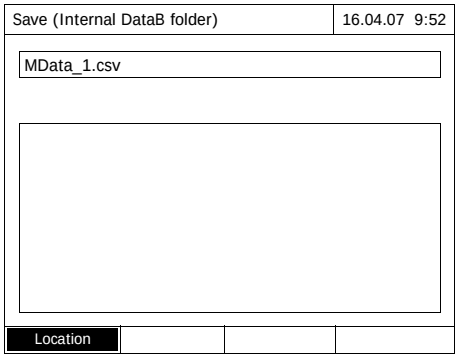
- Concentration
- Multi wavelengths
- Absorbance / % Transmission

The data stored in the measured value memory can be filtered with filter criteria and then exported to the PC-readable *.csv format.

The photometer automatically offers a file name during the storage procedure.

Example: Saving data from the measured value memory

<HOME>
Concentration,
Absorbance / % Transmission, or
Special / Multi wavelengths
├ *[Setup]*
├ *Measurement data memory*



1. If necessary, set the filter criteria with *[Setup]*.
2. Open the save dialog with **<STORE>**.

   The photometer automatically proposes the location *Internal DataB folder* and a file name.
3. If necessary, change the location with *[Location]* (*USB memory*).
4. If necessary, change the proposed file name.
5. Save the measurement data with **<START ENTER>**.

   The data are stored.
   If the photometer (*Internal DataB folder*) is selected as the location, the data can then be copied to a USB memory device (see section 4.12.1).

4.11.5 Saving measurement datasets automatically

For the measuring modes, *Concentration*, *Absorbance / % Transmission*, and *Special / Multi wavelengths* you can record every measured value automatically (*AutoStore*).

All automatically stored measurement datasets are given the ID "AutoStore". The "AutoStore" ID is overwritten if the same measured value is manually stored afterwards (**<STORE>**).
This ensures that every measurement dataset is stored in the data memory only once.

Activating *AutoStore*

Activate the *AutoStore* function as follows:

<HOME>
Concentration,
Absorbance / % Transmission, or
Special / Multi wavelengths
├ *[Setup]*
├ *Measurement data memory*
└ *Setup*

The available functions are displayed.

1 Select and confirm *AutoStore*.

The *AutoStore* function is active (✓).

Note
The *AutoStore* setting is valid for all three measuring modes, *Concentration*, *Absorbance / % Transmission*, and *Special / Multi wavelengths*.

4.11.6 Displaying measurement data memory

Depending on the operating situation, you can recall the measured value memory as follows:

From the main menu

<HOME>
[Setup],
├ *Measurement data memory*

In Concentration mode

Concentration
├ *[Setup]*
├ *Measurement data memory*

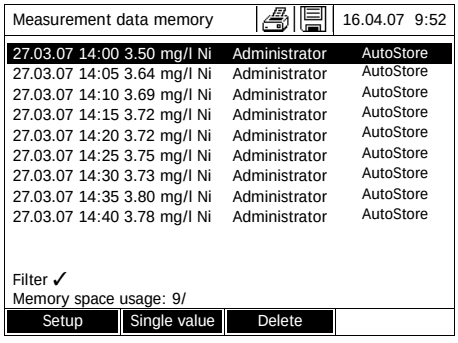
In Absorbance / % Transmission mode

Absorbance / % Transmission
├ *[Setup]*
├ *Measurement data*

In Special / Multi wavelengths mode

Special / Multi wavelengths
├ *[Setup]*
├ *Measurement data memory*

Each of these options indicates the contents of the measurement data memory as a list as follows.



If there are more datasets available than can be displayed, the arrows ▲ and ▼ are displayed additionally.

Filter✓ indicates that filter settings are active. In this case, only those datasets are displayed that correspond to the selected filter criteria (see section 4.11.7).

Options Measurement datasets can be

- displayed in short form as a list or in details as individual values ([List] <–> [Single value])
- filtered (see section 4.11.7 and section 4.11.8)
- deleted (see section 4.11.9).
- with **<STORE>**, you can store the entire displayed list as a *.csv file in the internal DataB folder or on a USB memory device connected to the USB-A connection. The filter settings apply to the storing process. You can freely select the file name. Thus you can, e. g. store in a separate file and systematically archive measurement data of a certain period.
- with **<PRINT>**, the entire displayed list can be printed. The filter settings apply to the print process.

4.11.7 Filtering measurement datasets

The functions to display, delete and download stored measurement datasets refer to all stored measurement datasets that correspond to the specified filter criteria.

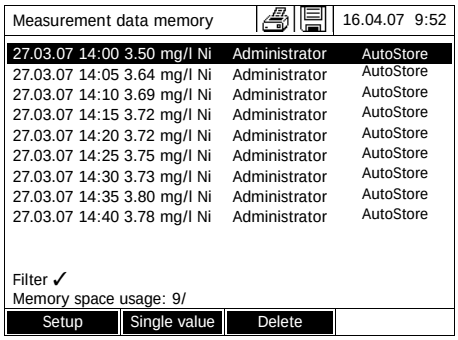
Filter criteria

The following filter criteria can be set:

- *Mode* (measured parameter)
- *User*
- *ID* (identification)
- *Date* (date *from* ... *to* ...)
- *Method* (for the measured parameters, *Concentration* and *Multi wavelength*)

<HOME>
Concentration,
Absorbance / % Transmission, or
Special / Multi wavelengths
- *[Setup]*
  - *Measurement data memory*
    - *Setup*
      - *Filter*

Filter
- *Mode (Concentration, etc.)*
- *User* (**<A...9>**)
- *ID* (**<A...9>**)
- *Date* (*from* ... *to* ...)
- *Method*



The filter setting menu is displayed.

1. Set the filter criteria.
2. If necessary, deactivate any selected filter criteria with *[Reset entry]*.
3. Confirm the filter selection with *[Apply]*.

The *Measurement data memory* list is displayed.

The following information is displayed additionally:

- Current memory occupancy
- Active filter criteria (*Filter* ✓)

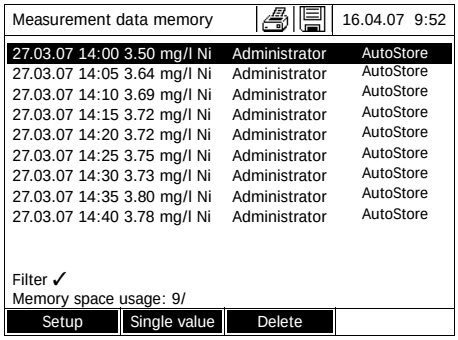
Note
Alternatively, you can hide measurement datasets that meet the specified filter criteria with the *Selected values: invert selection* function (see section 4.11.8).

4.11.8 Inverting filters

With the *Selected values: invert selection* function you can hide all measurement datasets that correspond to the specified criteria of the filter (see section 4.11.7).

Note
You can use this function to select and delete measurement datasets no longer used.

<HOME>
Concentration,
Absorbance / % Transmission, or
Special / Multi wavelengths
- *[Setup]*
  - *Measurement data memory*
    - *Setup*
      - *Selected values: invert selection*

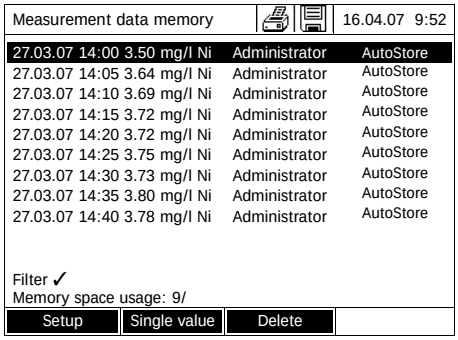


The *Measurement data memory* list is displayed. All measurement datasets corresponding to the filter criteria are hidden.

4.11.9 Erasing stored measurement datasets

If you no longer need any stored measurement datasets, you can erase them individually or altogether.

<HOME>
Concentration,
Absorbance / % Transmission, or
Special / Multi wavelengths
├ *[Setup]*
├ *Measurement data memory*



The *Measurement data memory* list is displayed.

The filter settings used last are active.

Erasure functions

The following erasure functions are available.

- Erasing an individual measurement dataset

1 Highlight a measurement dataset.

2 Remove the highlighted measurement dataset with *[Delete]*.

- Erasing all measurement datasets of the displayed list

1 Open the setting menu with *[Setup]*.

2 Select and confirm *Delete memory (selected values only)*.

All measurement datasets corresponding to the current filter criteria are erased.

or

- Erasing all measurement datasets

Select and confirm *Delete memory (all values)*.

All measurement datasets are erased.

4.11.10 Saving kinetic recordings, spectra and AQA files

After the following measurements, the *Save* dialog opens and prompts you to save the data in a *.csv file:

- *Kinetics*
- *Spectrum*
- AQA3/*MatrixCheck*

If the data are not saved in *.csv format, they are lost when the measuring mode is terminated.

Note
During a kinetic recording, the current measurement is always saved in the file, "KineticsBackup.csv" for safety reasons.

4.11.11 Saving data as a pdf file

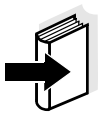
All data that can be printed (printer symbol on the display) can also be saved as a pdf file. The pdf file contains the data that are also output to a USB printer. Kinetic recordings and spectra are stored in the pdf file as a graphic.

To store data as a pdf file, use the **<PRINT>** key as for printing. When doing so, the pdf print has to be set as the printer in the menu, **<HOME>**/*General setup*/*Data transfer/Printer*/*Function of PRINT key*.

Subsequently, enter a file name and select the storage location (internally folder DataB or USB memory device).

4.12 Saving / exporting files

If you want to back up or process measurement data files outside the photometer, you can copy them to external media.



Note
Please follow the instructions on using USB memory devices (see section 4.11.2).

4.12.1 Copying all measurement data files to a USB memory device

Even if no PC is directly connected to the photometer, you can very simply transfer all measurement data files from the photometer (*Internal DataB folder*) to a connected USB memory device.

<HOME>
[Setup]
Save data to USB memory device

When the data saving procedure is finished, a message appears.

1 Confirm the message with **<STORE>**.

All measurement data files from the photometer (*Internal DataB folder*) have been transferred to the USB memory device.

The complete folder structure from the photometer is created on the USB memory device. The individual measurement data files are stored in subfolders sorted by measurement data types.

4.12.2 Copying user-defined methods / profiles to a USB memory device

<HOME>
[Setup]
Exchange methods/profiles /Store to USB memory device

A list is displayed that includes all user-defined methods and profiles available on the photometer. All methods and profiles are checked off with a checkmark.
All methods and profiles checked off are saved.

1 If necessary, select individual methods/profiles with **<▲><▼>** and remove the checkmark with**<START ENTER>**.

These methods/profiles will not be saved.

2 Start the save process with *[Store]*.

A message appears when the data have been saved.

3 Confirm the message with **<START ENTER>**.

The save process is completed. The data are stored in the *Exchange_Method_Profile* folder on the USB memory device. The individual files with the methods/ profiles are in subfolders.

Already existing files with identical names are overwritten without confirmation prompt.

4.12.3 Copying files to a PC

You can copy from the photometer to a PC the following data:

- Measurement data
- Spectra
- Kinetic recordings
- AQA records
- User-defined methods
- Profiles

After saving measurement data in *.csv or *.pdf format, you can copy them to a PC. Measurement data in csv format can be directly imported to and processed in spreadsheets such as Microsoft® Excel®.

Note
Depending on the country variant, some spreadsheet programs require a certain decimal separator for the correct import of numerical values (comma or point). The decimal separator can be selected in the following menu:

<HOME> -> *General setup* -> *Data transfer/Printer* -> *Decimal separator for csv-Files*.

Files containing measurement data can be copied to a PC in the following ways:

- By using a USB memory device as a temporary storage (see section and section 4.12.1). Subsequently, you can connect the USB memory device to a PC and read out the data.
- By means of the "SpectralTransfer" program
  (see operating manual of the "SpectralTransfer" program).
  The "SpectralTransfer" program and the corresponding operating manual is provided on the enclosed CD-ROM.

4.13 Importing files

You can import to a Spectroquant® Pharospectrophotometer the data that were created with the same or another Spectroquant® Pharo spectrophotometer, and the data that were saved to a USB memory device or a PC.

You can import the following data:

- Spectra
- Kinetic recordings
- User-defined methods
- Profiles

4.13.1 Importing spectra or kinetic recordings from a USB memory device

You can import to the photometer any spectrum or kinetic recording by opening an externally stored spectrum or kinetic recording with the Open function of the photometer.

4.13.2 Importing methods / profiles from a USB memory device

Note
When importing methods make sure that your photometer supports the wavelengths of the imported methods.

<HOME>
[Setup]
Exchange methods/profiles /Import from USB memory device

A list is displayed including all user-defined methods and profiles stored in the corresponding subfolders of the Exchange directory on the USB memory device.
All methods and profiles are checked off with a checkmark. All methods and profiles checked off are imported.

1 If necessary, select individual methods/profiles with **<▲><▼>** and remove the checkmark with**<START ENTER>**.

These methods / profiles are excluded from importing.

2 Start the import with *[Import]*.

A confirmation prompt appears before any data on the photometer are overwritten.

A message appears when the data have been imported.

3 Confirm the message with **<START ENTER>**.

The import is completed. The imported methods / profiles are available on the photometer.

4.13.3 Importing files from a PC

You can import files from the PC to the photometer in the following ways:

- By means of the "SpectralTransfer" program (user-defined methods only) (see operating manual of the "SpectralTransfer" program).
  The "SpectralTransfer" program and the corresponding operating manual is provided on the enclosed CD-ROM.

4.14 Printing data (RS232, USB)

4.14.1 Printer and terminal programs

Usable printers

Data can be printed with the following printers:

- Matrix printer connected to the RS232 interface
- Standard printer (ink or laser) connected to the USB-A interface

Note
Suitable are all printers that can interpret the PCL-3 printer control language.

The printer symbol indicates that the display contents can be printed. To print, press **<PRINT>**.

PC + terminal program

The data can also be received by a PC with terminal program instead of a printer. For this the PC is connected to the photometer via the RS232 interface. The output is identical to that of a matrix printer.

pdf file

As an alternative, you can also output the print data to a pdf file.

Note
In den following paragraphs, "Print" means:

- output to a printer (RS232 interface)
- output to a PC + terminal program (RS232 interface)
- output to a USB printer
- output to a pdf file.

4.14.2 Settings for data transmission

Settings are possible for the data transmission to a printer or PC.

Decimal separators for CSV files

For the output of CSV files you can select either a comma or a point as the decimal separator. The setting is made in the following menu:

<HOME> -> *General setup* -> *Data transfer/Printer* -> *Decimal separator for csv-Files* -> *Comma (12,34)* or *Point (12.34)*.

Short and long version

When printing measurement datasets, you can select a short or long version with different information contents. The setting is made in the following menu:

<HOME> -> *General setup* -> *Data transfer/Printer* -> *Data format (print)* -> *Short* or *Extended*.

Baud rate for RS232 interface

The baud rate can be set for printers that are operated at the RS232 interface. Adjust the Spectroquant® Pharo 300 to the baud rate of the printer. The setting is made in the following menu:

<HOME> -> *General setup* -> *Data transfer/Printer* -> *Baudrate for RS232 printer* -> 1200 ... 19200.

Printer

Here you can set which function is assigned to the **<PRINT>** key:

- Output to a USB printer
- Output as pdf file

The setting is made in the following menu:

<HOME> -> *General setup* -> *Data transfer/Printer* -> *Function of PRINT key* -> *USB printer* or *PDF file*.

4.14.3 Printing measurement datasets

This section describes how to print measurement datasets of the measuring modes, *Concentration*, *Absorbance / % Transmission*, and *Special / Multi wavelengths*.

By means of sample printouts, the printed information is described below:

Concentration

```
21 05.06.07 14:05:41 14541 844 mg/l COD     Inlet
   Administrator 0.005 02.06.07 11:02:13 2 AQA1: 9 AQA2: 14
```

and *Special / Multi wavelengths* mode

Structure of the lines from left to right:

1st line:

[Consecutive no.] [Date] [Time] [Method name] [Measured value] [Unit] [Citation form] [Dilution] [ID or "AutoStore"]

2nd line (long version only):

[User] [Reagent blank value] [Date of blank value measurement] [Time of blank value measurement] [Lot ID of blank value measurement] [AQA1: label] [AQA1: record no.] [AQA2: label] [AQA2: record no]

Note
Optional elements (e.g. dilution or ID) are output only if they were really used for measurement or storage.

Absorbance / % Transmission

```
14 05.06.07 11:25:01 445 nm  0.609 Absorbance  AutoStore
   Administrator 0.133 02.06.07 09:59:01 AQA1: 9
```

Structure of the lines from left to right:

mode

1st line:

[Consecutive no.] [Date] [Time] [Wavelength] [Measured value] ["Absorbance" or "Transmission" mode] [ID or "AutoStore"]

2nd line (long version only):

[User] [Value of reference absorbance] [Date of reference absorbance] [Time of reference absorbance] [AQA1: label*] [AQA1: record no.]*

Note
Optional elements (e.g. ID or reference absorbance) are output only if they were really used for measurement or storage.

4.14.4 Printing Kinetics records

Sample printout

```
Pharo 30009130512 1.30-Merck-1.60 Administrator
05.06.07 12:14:55
320 nm

Time [s]            Absorbance
6                   0,092
17                  0,077
25                  0,073
35                  0,077
..                  .....
..                  .....
(etc.)
```

Structure of the lines from left to right

1st line:

[Instrument type] [Series number] [Version of meter software and method data] [User]

2nd line:

[Start date] [Start time]

3rd line:

[Wavelength]

6th and following lines:

Passed time with related measured value

Note
If you output a kinetic recording to a USB printer or pdf file (not to the RS232 interface), the current graphic representation is shown on the display.

4.14.5 Printing spectra

Sample printout

```
Pharo 30009130512 1.30-Merck-1.60 Administrator
07.06.07 09:47:00

Wavelength [nm]                                Absorbance
320                                            0,238
321                                            0,240
322                                            0,241
323                                            0,240
324                                            0,239
...                                            .....
...                                            .....
(etc.)
```

Structure of the lines from left to right

1st line:

[Instrument type] [Series number] [Version of meter software and method data] [User]

2nd line:

[Start date] [Start time] [Wavelength]

5th and following lines:

Wavelength with related measured value

Note
If you output a spectrum to a USB printer or pdf file (not to the RS232 interface), the current graphic representation is shown on the display.

4.15 Analytical quality assurance (AQA)

4.15.1 General information

The target of the analytical quality assurance (AQA) is to secure correct and precise measurement results.

Note
Settings for AQA checks are only available for users of the user group, administrator.
Every registered user can carry out the AQA check (see also section 4.16.1).

Analytical quality assurance (AQA) can be carried out in two steps independent of each other:

- AQA1: Monitoring of the photometer
- AQA2: Monitoring of the total system.
  It comprises the photometer, the used test, the accessories and the user's way of working.

The monitoring includes a check procedure that has to be successfully repeated by the user within a certain period (AQA interval).

Note
The AQA monitoring is not active in the delivery condition.

AQA in measured value documentation

All values that are measured after a passed check and within the AQA interval are given the addition *Protocol ID* in the measured value documentation. This addition is used to identify the relevant AQA inspection record.

4.15.2 Photometer monitoring (AQA1)

At least one set of test standards such as Spectroquant® PhotoCheck or CertiPUR® is required for the photometer monitoring.
The administrator specifies which test standard has to be used as the minimum requirement for the AQA1 monitoring.
The extent of the monitoring can be enlarged with further test standards.

Note
Settings for AQA checks are only available for users of the user group, administrator.
Every registered user can carry out the AQA check (see also section 4.16.1).

Spectroquant® PhotoCheck

The PhotoCheck consists of 12 test standards in duplicate, 2 zero cells and 2 cells to check the barcode reader. Each PhotoCheck package contains a lot dependent test certificate with all nominal values (absorbances) and tolerances of the test standards. These values are entered in the photometer during the configuration of the AQA1 check.

CertiPUR® test standards

Each CertiPUR® standard is provided with a lot dependent test certificate with all nominal values (absorbances) and tolerances of the test standards. The values were preset in the factory.

Note
Observe the shelf life of the test standards. The values in the photometer always have to be checked when a new package of test standard is used. If necessary, adjust the values at the photometer.

Overview of the photometer monitoring

Photometer monitoring (AQA1) consists of the following parts:

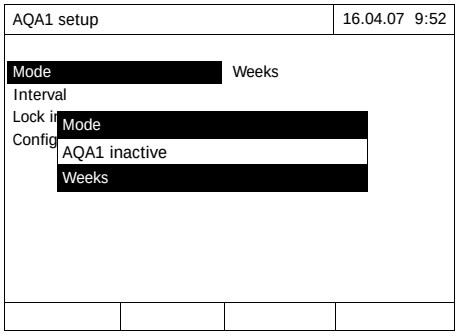
- Configuring settings in the *AQA1 setup* menu.
  - Activate AQA1
  - Specify AQA1 Interval
  - Activate/deactivate the meter lock for missing or expired AQA1 check
  - Define the extent of the AQA1 monitoring by activating or deactivating the individual test standards.
  - Enter the nominal values, tolerances and lot numbers for the individual test standards
- Carrying out the AQA1 check. The photometer compares the results with the nominal values while taking into account the tolerances.

The steps are described in detail below.

Activating AQA1

The AQA1 monitoring is activated in the *Mode* menu:

<HOME>
[AQA]
├ *AQA1 setup*
  ├ *Mode*



Select and confirm *Weeks*.

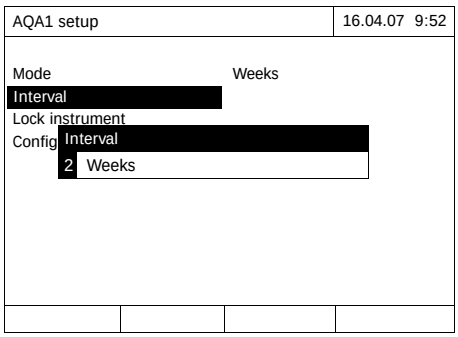
AQA1 is active.
The *Interval* setting indicates *Weeks* as the interval unit.

Defining the AQA1 Interval

The AQA1 Interval defines the interval between two AQA1 checks.
When an interval has expired, the following consequences become effective:

- Warning and loss of the AQA1 labeling
- Locking of the photometer against all measurements (if activated).

<HOME>
[AQA]
├ *AQA1 setup*
  ├ *Interval*



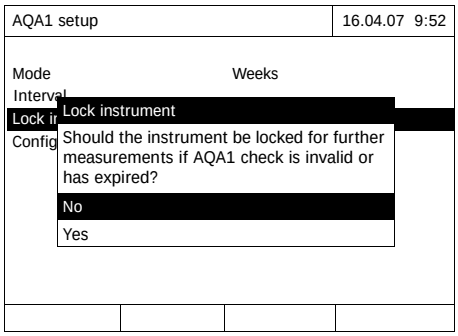
1 Enter a numeric value (2 to 52 weeks) (**<0...9>**) and confirm

The *Interval* defined for the AQA1 check is active.

Configuring the lock of the photometer

Here you configure whether or not the photometer will be locked against all measurements if there is no valid AQA1 check or the interval for the AQA1 check has expired.

<HOME>
[AQA]
AQA1 setup
Lock instrument

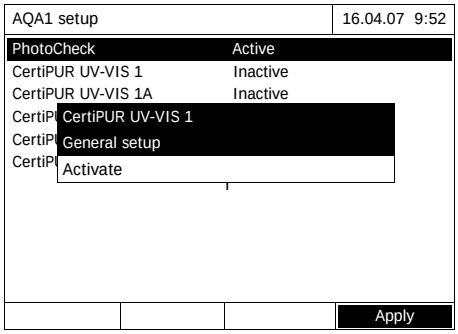


1 Select and confirm *Yes*.

The photometer is locked against all measurements if the AQA1 check is invalid or the AQA1 interval has expired.

Configuration of tests ...

<HOME>
[AQA]
AQA1 setup
Configuration of tests ...



All possible test standards or test standard sets are listed.

1 Select and confirm a test standard or test standard set.

2 Adjust and confirm the extent of the monitoring with *Activate* or *Deactivate*.

3 Confirm the test standard (set) once again.

4 Switch to the adjustment of the nominal values and tolerances with *Setup*.

PhotoCheck			16.04.07 9:52
Lot number:			HC616115
Use by			16.04.2008
		Target value	Tolerance
445/1		0.196	± 0.020
445/2		0.500	± 0.030
445/3		0.998	± 0.040
445/4		1.508	± 0.050
525/1		0.197	± 0.020
525/2		0.495	± 0.030
525/3		0.992	± 0.040
525/4		1.496	± 0.050
			Apply

Example, PhotoCheck:

5 Using **<▲><▼>** and **<◀><▶>**, select the *Lot number*, *Target value* or *Tolerance* entries and open them for editing with **<START ENTER>**.

6 Enter and confirm the required value (**<0...9>**)

7 Accept all values with *[Apply]*.

Carrying out the AQA1 check (example: PhotoCheck)

The AQA1 check comprises the check with all test standards activated in the menu, *AQA menu* / *AQA1 setup* / *Configuration of tests ...* for AQA1 (see page 143).

First, a zero adjustment for all wavelengths takes place.
Subsequently, the first individual checks with the selected test standards take place (e.g. PhotoCheck).

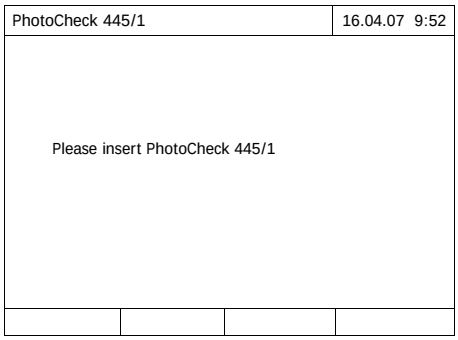
<HOME>
[AQA]
├ *AQA1 check*

PhotoCheck			16.04.07 9:52
Reference measurement Please insert zero cell (distilled water).			

The photometer is ready for the zero adjustment.

1 Insert the zero cell.
The cell is automatically recognized and the zero adjustment is started for all wavelengths.

After the successful zero adjustment, the photometer is ready to measure the PhotoCheck test standard
445/1.



2 Insert the cell.
The cuvette is automatically recognized and the measurement started.

After measuring, the measurement result, Target value, Tolerance and an evaluation (OK or failed) are displayed.

The photometer offers to repeat the measurement if the check failed.

If the check was successful, the measurement of the next PhotoCheck test standard, e.g. 445/2, appears on the display.

3 Measure all test standards in the same way.
After all test standards are successfully measured, the check is passed.

Test record

A test record is displayed after the check. It can be printed and stored as a file (in the internal DataB folder or USB memory device at the USB-A connection, see section 4.11.1).

Sample printout:

```
Pharo 30009130512 1.30-Merck-1.60 Administrator
AQA1                                        OK
Protocol ID                                 9
Executed by:                                Administrator
Executed                                    22.05.2007
Valid until:                                26.06.2007

PhotoCheck          OC479094                OK
445-1               0.200 +- 100            0.192
445-2               0.500 +- 200            0.511
445-3               1.000 +- 200            1.006
445-4               1.500 +- 200            1.526
525-1               0.200 +- 200            0.247
.....               ............            .....
.....               ............            .....
(etc.)
```

Note
Afterwards you can view the last AQA1 test record under *AQA1 info*.

4.15.3 Total system monitoring (AQA2)

For the total system monitoring, standard solutions with a defined analyte content are required (preferably certified Spectroquant® CombiCheck standards).

Note
Settings for AQA checks are only available for users of the user group, administrator.
The AQA check can be carried out by any registered user.

Spectroquant® CombiCheck

Spectroquant® CombiCheck standards are multiparameter standards ready to use, i. e. they can be used for several test sets (methods).

In addition to the CombiCheck standards, one parameter standard solutions can also be used. They are prepared by dilution to the respective end concentration. The end concentration should be in the middle of the measuring range.

Note
The suitable CombiCheck standards and one parameter standards are listed in the Merck catalog or on the Internet.

Overview of the total system monitoring

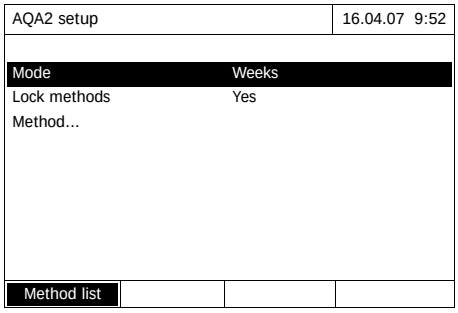
Total system monitoring (AQA2) consists of the following parts:

- Configuring the general settings in the *AQA2 setup* menu.
  - Activate AQA2
  - Select the AQA2 interval unit (Weeks or Measurements)
  - Activate/deactivate the measurement lock for missing or expired AQA2 check. The measurement lock is effective for all methods that were activated for AQA2 monitoring
- Selecting the method to be activated for AQA2
- Configuring the method-specific settings in the *AQA2 setup* menu.
  - Activate AQA2
  - Specify AQA2 Interval
  - Enter the nominal value, tolerance and designation (standard ID) for the test standard
- Carrying out the AQA2 check. During the check the test is carried out with the standard solution as the sample while the other conditions are the same. The photometer compares the result with the nominal value while taking the tolerance into account.

The steps are described in detail below.

General AQA2 settings

<HOME>
[AQA]
AQA2 setup



1. Select and confirm *Mode*.
   The *Mode* selection field pops up.
2. Select and confirm *Weeks* or *Measurements*.

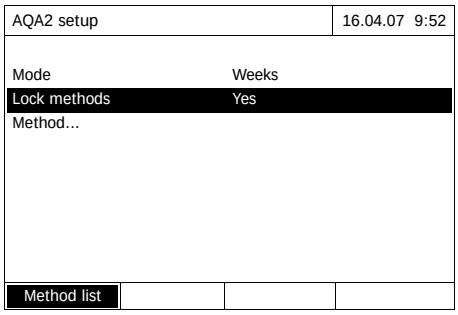
   AQA2 is active. For all methods, the AQA2 intervals are entered either in weeks or number of measurements.
3. Accept the general settings with *[Apply]*.

Note
When the mode (*Weeks* or *Measurements*) is changed, all AQA2 intervals are reset to the preset values.

Locking the method

Here you configure whether or not a method will be locked against measurement if there is no valid AQA2 check or the interval for the AQA2 check has expired.

<HOME>
[AQA]
AQA2 setup



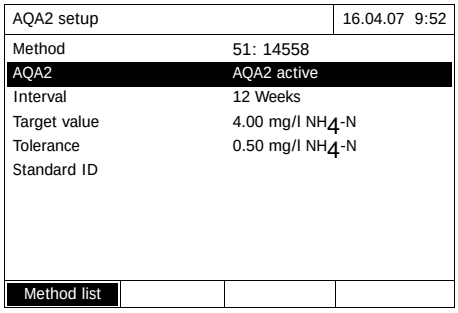
1. Select and confirm *Lock methods*.
2. Select and confirm *Yes*.

   The method lock is enabled.

   Each method will be locked if the AQA2 check is invalid or the AQA2 interval has expired.

Activating AQA2 monitoring for a method

<HOME>
[AQA]
├ *AQA2 setup*
  ├ *Method...*



1 Select a method (see section 4.5.3).
2 Select and confirm *AQA2*.
3 Select and confirm *AQA2 active*.
AQA2 is active for this method.

Defining the AQA2 Interval, nominal value and tolerance

The AQA2 Interval defines the interval between two AQA2 checks.
When an interval has expired, the following consequences become effective:

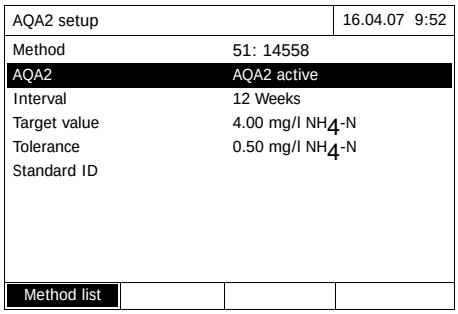
- Warning and loss of the AQA2 labeling
- Locking of the method against measurement (if activated).

Setting range:

1 to 12 weeks (default: 12 weeks) or

1 to 10000 measurements (default: 200 measurements)

Note
The unit of the AQA2 interval (Weeks or Measurements) is defined in the line, *Mode* (see page 147).

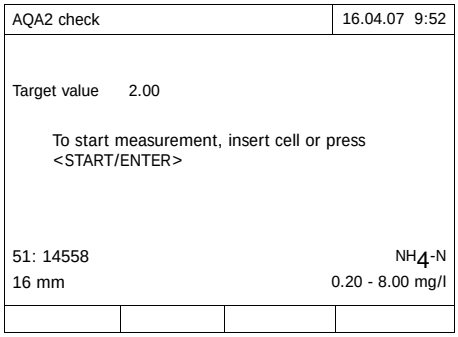


4 Select the *Interval* and enter the AQA2 interval.
5 If necessary, adjust the values for *Target value* and *Tolerance*.
6 Optional: Select *Standard ID* and enter a designation. The designation is recorded in the AQA2 documentation.

Repeat the steps 1 to 8 if you want to configure further tests for AQA2.

Carrying out the AQA2 check for a method

<HOME>
[AQA]
├ *AQA2 check*



1 Carry out the check like a normal measurement (see section 4.5.1 to 4.5.3).

2 Insert the cell or start measurement with **<START ENTER>**.

After the measurement is completed, the result and its evaluation are displayed.

If the check failed, it is possible to repeat the measurement.

If the check was successful, the *AQA2 check* function is finished.

Test record

A test record is displayed after the check. It can be printed and stored as a file (in the internal DataB folder or USB memory device at the USB-A connection, see section 4.11.1).

Sample printout:

```
Pharo 30009130512 1.30-Merck-1.60 Administrator
AQA2                OK
Protocol ID         32
Executed by:         Administrator
Executed            21.05.2007
Valid until:        13.08.2007

Method              55: 14543 PO4-P
Standard ID         CC10 OC557775
Target value        0.80 +- 0.08 mg/l
Measured value      0.84    mg/l
```

Note
Later you can view the last AQA2 test records for all methods monitored with AQA2 under *AQA2 info*.

4.15.4 AQA3/MatrixCheck

The *MatrixCheck* is used to check if the photometric determination is disturbed by other substances present in the sample (sample matrix). The MatrixCheck can be carried out by spiking or diluting:

The photometer enables a simplified MatrixCheck with the aid of the Spectroquant® CombiCheck R-2 addition solution. The MatrixCheck can be carried out immediately. The volumes required for the sample and standards are displayed on the screen. The MatrixCheck is then carried out with a single spiking.

For the MatrixCheck with a standard of your own, however, you can enter the number of spikings or dilutions yourself (max. 3).

Note
Settings for AQA checks are only available for users of the user group, administrator.
The AQA check can be carried out by any user.

MatrixCheck by spiking

For the MatrixCheck by spiking, the photometric determination is repeated after a defined amount of analyte has been added to the test sample in the form of standard solutions.

The nominal value for the determination is calculated from the added amount of analyte, provided that there is no disturbance due to the sample matrix. After the photometric determination the measured value is compared to the nominal value and the recovery rate is calculated. A matrix disturbance is likely if the recovery rate is less than 90 % or more than 110 %.

MatrixCheck by diluting

For the MatrixCheck by dilution, the photometric determination is repeated after the test sample has been diluted with distilled water.

The nominal value for the determination is calculated from the dilution, provided that there is no disturbance due to the sample matrix. After the photometric determination the measured value is compared to the nominal value and the recovery rate is calculated. A matrix disturbance is likely if the recovery rate is less than 90 % or more than 110 %.

Practical instructions

- After evaluating the measured value of the sample the photometer suggests for the MatrixCheck to spike or dilute the sample and standard with suitable volumes.
  You can change the suggested values of the volumes for the sample and standard. The photometer checks your entries and informs you of errors (e.g. if a nominal value is outside the measuring range of the test).
  For each spiking or dilution, the relevant nominal concentration value is displayed.
- To be able to reliably recognize matrix effects by spiking, the volume increase after spiking should be small.
- To be able to reliably recognize matrix effects by diluting, the dilution factor should be high.
- You can carry out the MatrixCheck as a series of measurements, consisting of up to three determinations with different spiking volumes or dilutions respectively.
- Prepare all test sample solutions simultaneously at the beginning of the series of measurements.

Overview of the AQA3/MatrixCheck

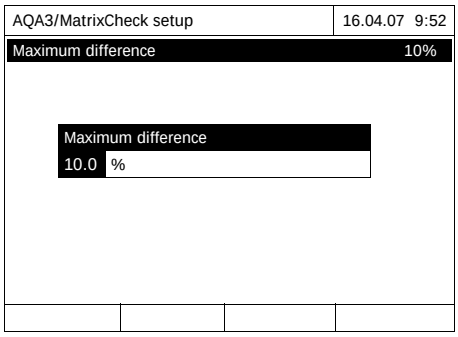
The MatrixCheck consists of the following parts:

- Configuring settings in the *AQA3/MatrixCheck setup* menu.
  - Specify the maximum deviation from the nominal value after spiking or diluting (default setting: 10%)
- Carrying out the AQA3 / MatrixCheck

Specifying the maximum deviation from the nominal value

The assessment of the recovery rate is determined with the maximum deviation from the nominal value. The assessment of the recovery rate is displayed next to the recovery rate after the check has been carried out.

<HOME>
Concentration
[Setup]
AQA
AQA3/MatrixCheck setup
Maximum difference

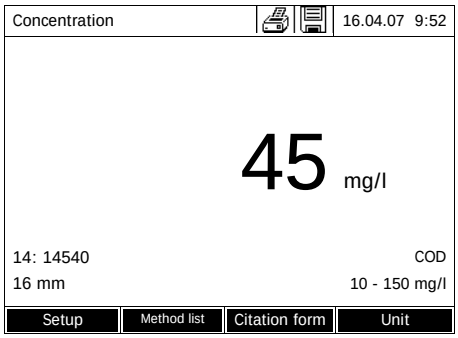


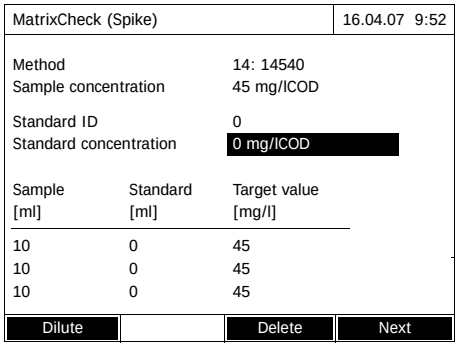
1 Enter and confirm a numerical value.

The setting is active.

2 Exit the menu with **<ESC>**.

Carrying out the MatrixCheck





1 Measure the original sample without spiking or diluting it (see section 4.5.1 to 4.5.3).

2 The measured value is displayed.

3 Open the setting menu with *[Setup]*.

4 Select and confirm *AQA*.

5 If necessary, check the settings in the menu, *AQA3/MatrixCheck setup*.

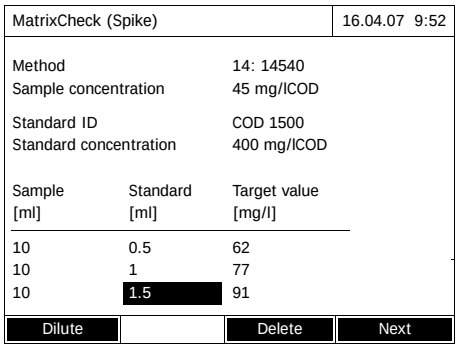
6 Select and confirm *AQA3/MatrixCheck*.

The display for the MatrixCheck opens up.

If the spiking with the standard values of the CombiCheck R-2 suggested by the photometer would cause the measuring range to be exceeded, the MatrixCheck by diluting is automatically suggested.

Note

The following description shows the proceeding for the MatrixCheck by spiking. To switch to the MatrixCheck by dilution, use the *[Dilute]* function key. The proceeding is similar there, but the entry of the Standard ID and Standard concentration is not applicable.



7 In the*Standard ID* entry field, select the simplified MatrixCheck with the CombiCheck standard solution or enter a designation for another standard solution used.

If the CombiCheck is selected, no more entries are required (continue with step 10).

8 Enter the concentration of the used standard solution in the *Standard concentration* entry field.

Specifying the series of measurements:

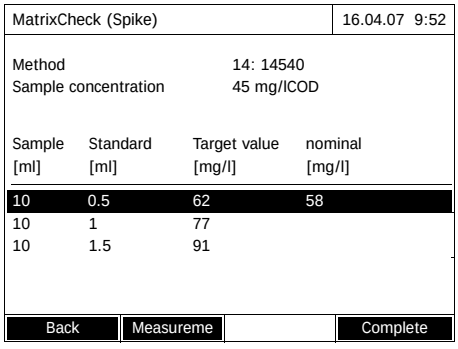
9 Enter the volumes of sample and standard of the individual test sample solutions in the columns, *Sample [ml]* and *Standard [ml]*. The nominal value is calculated after each entry.

- You can delete a measurement from the series of measurements with *[Delete]*.

Note that all nominal values have to be within the measuring range of the test.

10 Using *[Next]*, accept all entries on the page and switch to the next page. The entries are checked by the photometer.

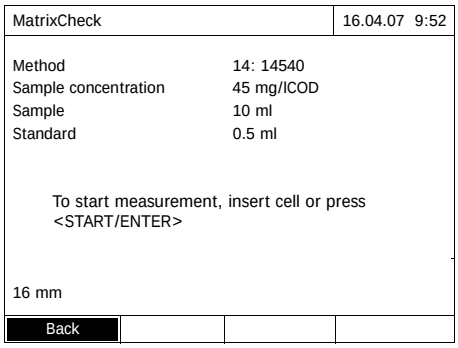
The photometer is ready to carry out the series of measurements.



Carrying out the series of measurements:

According to the program, the samples are measured top down. You can, however, select the samples yourself and thus change the order with **<▲><▼>**.

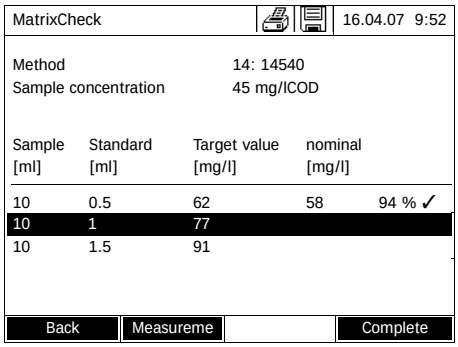
11 Use *[Measurement]* to proceed to the measurement of the (first) sample.



The measurement display appears.

12 Insert the cell with the respective sample.

The sample is measured.



After the measurement, the recovery rate is displayed in the right table column.

The assessment of the recovery rate is displayed next to the recovery rate (✓ or ✗).

The criteria for the assessment are determined in the menu, *AQA3/MatrixCheck setup* / *Maximum difference*.

13 If necessary, repeat the steps 11 and 12 for the remaining samples.

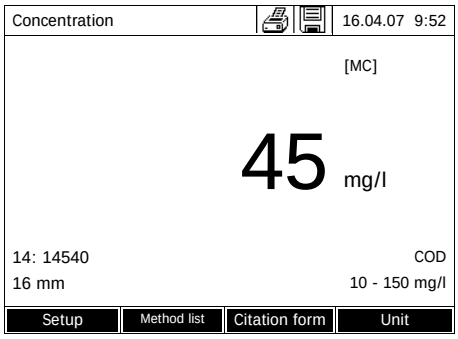
14 Use *[Complete]* to complete the MatrixCheck.

The *Save* dialog box pops up.

15 If necessary, change the storage location with *[Location]*:
Internal DataB folder:
Exchange folder in the instrument
or
USB memory:
USB memory device connected at the USB-A connection.

16 If necessary, change the file name.

17 Save the file with **<START ENTER>**.



The display returns to the measured value display of the original sample without spiking / dilution.

The [MC] status indicator is displayed. A MatrixCheck was carried out for this measured value.

Test record

The result of the MatrixCheck is displayed in a test record. You can print this record and save it as a file.
To save the file in the photometer, select the *Internal DataB folder* as the location. To save the file in an external USB memory device at the USB-A connection, select *USB memory* as the location (see section 4.11.1).

Sample printout:

```
Pharo 30009130512 1.30-Merck-1.60 Administrator
MatrixCheck         OK
Protocol ID         7
Method              14: 14540 COD
Sample concentration45    mg/lCOD
Standard ID         COD 1500
Standard concentration400    mg/lCOD

Sample              Standard                Target value
Actual value
ml                  ml                      mg/lmg/l
10                  0.5                     625894% OK
10                  1                       777192% OK
```

4.16 User management

The functions of the user management are only available for users of the user group, *Administrator*.

An administrator can

- activate or deactivate the user management for the meter
- create, change or delete individual user accounts.

4.16.1 User levels and user rights

The Spectroquant® Pharo 300 allows the management of up to 100 users. Every user is member of a user group with defined user rights.

User groups

There are three hierarchical user groups:

- *Administrator* (top level)
- *User* (user account registered by the administrator)
- *Guest* (user without user account)

Administrators and users log in to the photometer with their user name and password. Guests can optionally enter a name for their login. Thus, documented measured values can later be assigned to the user.

User rights in detail

Action	*Administrator*	*User*	*Guest*
Select methods	✓	✓	✓
Carry out measurements	✓	✓	✓
Store measurement data	✓	✓	✓
Check photometer (AQA1)	✓	✓	⊘
Check total system (AQA2)	✓	✓	⊘
AQA1 measured value labeling	✓	✓	✓
AQA2 measured value labeling	✓	✓	⊘
Edit user-defined methods	✓	✓	⊘
Exchanging methods / profiles	✓	⊘	⊘
Change AQA settings	✓	⊘	⊘
Clear the memory	✓	⊘	⊘
Set the date and time	✓	⊘	⊘
Administrate users	✓	⊘	⊘
Reset photometer settings	✓	⊘	⊘
Carry out software update	✓	⊘	⊘

Note
You can also switch off the user management and reactivate it as necessary.

To do so, you need administrator rights. If the user management is switched off, the user name and password do not have to be entered. Each user has full rights.

4.16.2 Activating or deactivating the User management function

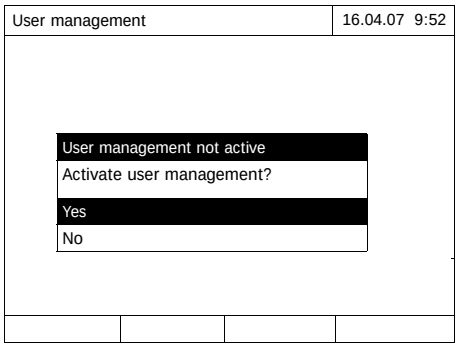
Each user can activate the user management function.
If the function is deactivated, each user has administrator rights.

Only members of the user group, administrator can deactivate the user management function.

If the function is active, each user has to log in to the photometer. After the login, the user has certain rights depending on the user group.

Activating the user management function

<HOME>
[General setup]
├ *User management*



1 Select and confirm *Yes*.

The user management function is active.

Activating the user management creates an administrator user account. The user name is "Administrator". The preset password is "admin". Change this password as soon as possible.

Deactivating the user management function

<HOME>
[General setup]
├ *User management*
├ *[Setup]*
├ *Deactivate user management*

The user management function is inactive.

Each user has administrator rights.

Note
If the user management is deactivated by a user of the *Administrator* user group, all user accounts that were set up are lost. The password for the administrator is reset to "admin".

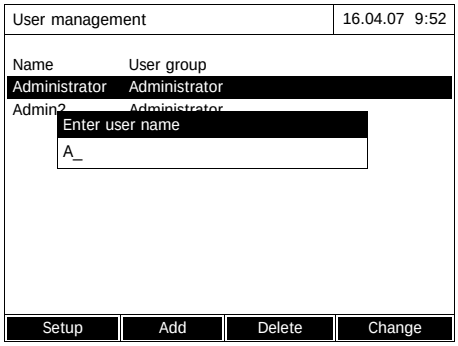
4.16.3 Creating, changing or deleting a user account

When the user management function is active, a user with administrator rights can administrate user accounts.

Creating a user account

During the creation of a user account, the *Name*, whether or not the user belongs to a *User group* and the *Password* are defined.

<HOME>
[General setup]
├ *User management*
  ├ *[Add]*



The input field for the new user name pops up.

1 Enter the user name (**<A...9>**) and confirm.

The selection field for the user group (*Administrator* / *User*) pops up.

2 Select and confirm the user group.

The input field for the password pops up.

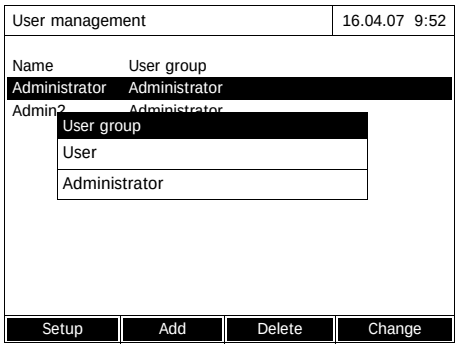
3 Enter the password (**<A...9>**) and confirm.

The user account is created and appears in the list of user accounts.

Editing a user account

When a user account is changed, the *User group* and *Password* can be changed.

<HOME>
[General setup]
├ *User management*



1 Select a user account.

2 Press *[Change]*to edit the user account.

The selection field for the user group (*Administrator* / *User*) pops up.

3 If necessary, select and confirm another user group.

The input field for the password pops up.

4 If necessary, enter (**<A...9>**) and confirm another password.

The user account is changed and appears in the list of user accounts.

Deleting a user account

<HOME>
[General setup]
User management

1 Select a user account.

2 Delete the user account with *[Delete]*.

A security prompt appears: *Confirm deletion ?*

3 Confirm the security prompt.

The user account is deleted.

4.16.4 Login with active user management

To be able to always assign measurement data to a user, the administrator can activate the user management function. After doing so, the photometer can only be operated after login with a user name. Depending on the authorization class (administrator, user, guest), important settings are released for changes or locked.

Note
The user management function is not active in the delivery condition of the Spectroquant® Pharo 300. Every user can carry out all functions.

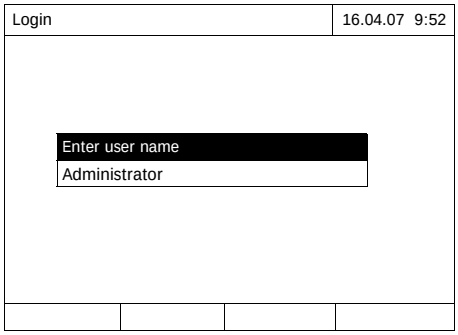
Activating the user management creates an administrator user account. The user name is "Administrator". The preset password is "admin".
Change this password as soon as possible.

Make sure to use the correct spelling (upper and lower case) of user name and password for the login.

After logging in to the *Administrator* group with a user name, you can create further users or administrators or switch off the user management function.

The *Login* window with the *Enter user name* prompt appears after the meter has been switched on and after a user has logged off.
In the following example, a user will log in with the user name, "Administrator".

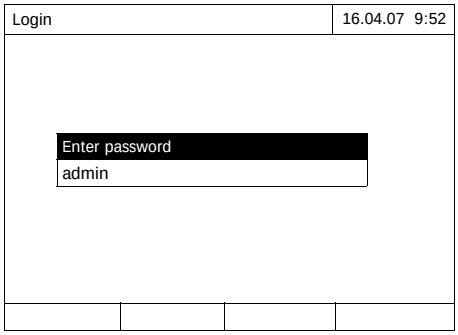
The photometer is switched on. The *Login* dialog is displayed.



1 Enter the user name (**<A...9>**) and confirm.

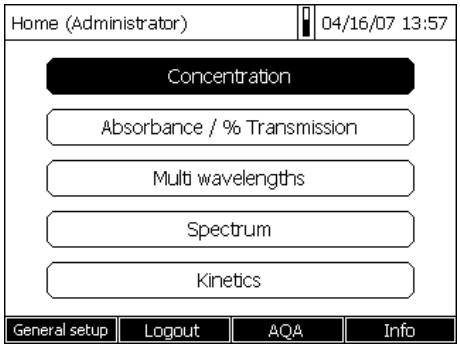
The input field for the password pops up.

If the user name is not known (or incorrectly spelled) it is possible to log in without a password as a guest with restricted rights (see section 4.16.1).



2 Enter the password (**<A...9>**) and confirm.

If the password is written correctly (note upper and lower case), the *Home* main menu opens up. The entered user name is displayed.

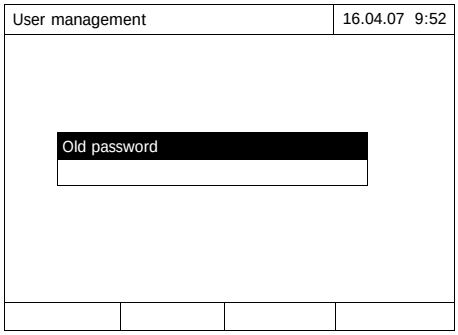


4.16.5 Changing the password

The administrator sets up user accounts and assigns a password to each user account.

As soon as any user has successfully logged in with the password, they can change the password for their user accounts themselves.

<HOME>
[General setup]
├ *User management*
  ├ Change password



1 Enter and confirm the old password.
2 Enter and confirm the new password.

The password is changed.

4.17 Reset

You can reset (initialize) the measurement settings or all settings.

Note
The *Reset* function is available for users of the user group, Administrator only.

You have the following options of resetting the photometer settings:

● *Reset configuration*	All settings except for the measurement data memory, user-defined methods and measured blank values are deleted.
● *Delivery condition*	All settings (including measurement data memory and user-defined methods) are deleted and the photometer is reset to the delivery condition.

<HOME>
[General setup]
├ *Reset*

The menu where to select the reset type (*Delivery condition* / *Reset configuration*) is displayed.

1 Select and confirm the reset type.

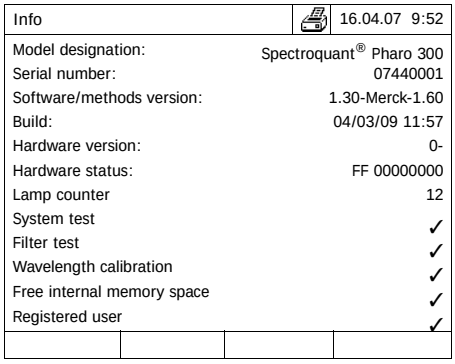
The reset is carried out.

4.18 Photometer information ([Info])

The following photometer information is displayed:

- Photometer designation
- Version number of the meter software/method data
- Hardware version
- Series number of the meter
- Registered user
- Hardware status (for service purposes)
- Memory status

<HOME>
[Info]



The meter information and result of the self-test are displayed and can be printed.

4.19 Lamp counter

The photometer counts the operating hours of the lamp. The information on the operating hours of the lamp is given in the *Info* menu.

The number quoted there corresponds to the number of flashes.

4.20 Software and methods update

The software and method update is used to continuously update your photometer.

Note
Only members of the user group, *Administrator* may carry out any software and method updates.

The update comprises

- the newest firmware (meter software)
- new or changed method data

Note
User-defined data (such as settings, user-defined methods or measured data) are not changed by a software and methods update.

The current software version is available on the Internet under www.analytical-test-kits.com.

The software can be transmitted to the photometer as follows:

- by means of a USB memory device as a temporary storage (section 4.20.1).
- by means of a USB connection between a PC and the photometer (section 4.20.2).

4.20.1 Update using a USB memory device

Store the new software required for the update on the USB memory and connect it to the photometer.

Execution

1 Connect the USB memory device to the PC.

2 Unpack the contents of the downloaded exe or zip file with the entire folder structure in the main directory (top level) of the USB memory.

Note
Make sure the folder structure of the files is retained during the unpacking process.
If you use a program such as WinZip to unpack the files, the option, "Nutze Ordnernamen" or "Use Folder Names" must be set. Details are given in the documentation of your unpack program.

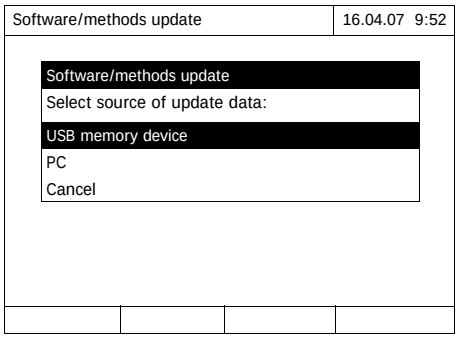
The USB memory must have the folder "Update" on the top level. The Update folder comprises several subfolders.

The following steps are carried out at the photometer.

3 Connect the USB memory device to the photometer.

4 Switch on the photometer if necessary.

<HOME>
[General setup]
Software/methods update



5 Using **<▲><▼>**, select *USB memory device* as the source and press **<START ENTER>**.

The update process takes approx. five minutes.
Subsequently, the photometer switches itself off and then on again.

Note
If the update cannot be carried out, an error message appears on the display. Check whether the "Update" folder with its subfolders is stored on the USB memory device (top level).

4.20.2 Update using a PC

The SpectralTransfer PC software supports the software and method update to Version 1.1x.
From version 1.20 this function is no longer supported.

4.20.3 Language update

If you want to set some special languages on your photometer (e.g. Chinese or Thai), a character set extension is required to display the characters.

You can install the additional character sets with a corresponding language update. After the installation, the character sets will occupy some of the storage space of the photometer:

- Chinese: 2 MB
- Thai: 0.3 MB

The language updates are on the CD-ROM provided with the photometer.

Note
A language update cannot be undone. Therefore, we recommend to carry out the language updates only if they are really required.

Before the update

Before carrying out the language update, make sure the current software version is installed on the photometer. It is available on the Internet as an update. Download this software update and install it before starting the installation of the language updates.

Requirements

Free storage space on the photometer is required, depending on the character set to be installed and the installation procedure:

Character set	Storage space required for installation via	
	USB storage medium	PC
Chinese	2 MB	4 MB
Thai	0.3 MB	0.6 MB

Note
You can view the currently available free storage space on the photometer in the
Info menu (F4 key). If less free storage is available than required for the update, the update is not possible. You can back up and erase from the photometer measurement data so that enough free storage is made available.

Execution

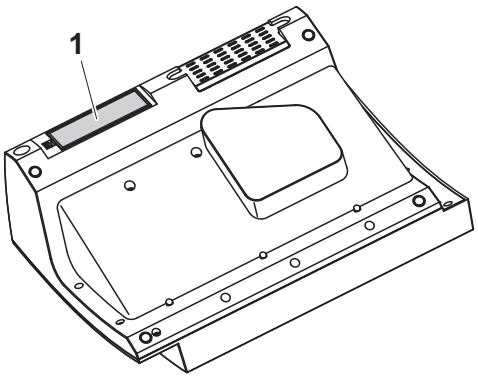
The update is executed in the same way as a software and method update and takes approx. 2 minutes. All files required for the update are in a zip archive or a self-unpacking exe file ("FontXXXXXX.zip" or "FontXXXXXX.exe") on the CD-ROM. It also includes a Readme file with detailed installation instructions for the language update.

5 Maintenance and cleaning

5.1 Exchanging the buffer batteries

CAUTION
There is a risk of explosion if unsuitable batteries are used. Only use leakproof alkaline manganese batteries.

Note
If you leave the photometer switched on during the exchange or insert the new batteries within a minute after taking out the old ones, the date and time are retained in the photometer.



1. Turn the photometer upside down and place it on a soft surface.
2. Open the lid of the battery compartment (1).
3. Remove the old batteries from the battery compartment.
4. Insert the four new batteries in the battery compartment. Make sure that the poles of the batteries are in the correct position.
   The ± signs on the batteries must correspond to the ± signs in the battery compartment.
5. Close the lid of the battery compartment.

Battery service life

The power consumption of the clock is very low. The lifetime of high quality batteries is at least 5 years.

Disposal of batteries

Dispose of the batteries at a suitable facility according to local legal requirements. It is illegal to dispose of the batteries with household refuse.

Within the European Union, the batteries are removed at a specialized treatment center at the instrument's end of life. The instruments are taken to one of those specialized treatment centers via the recycling system set up for this purpose.

5.2 Cleaning

Especially after a cell has broken or after a reagents accident, the photometer should immediately be cleaned (see also section 6.1 ACTIONS IN THE CASE OF A BROKEN CELL).

5.2.1 Cleaning the enclosure

CAUTION
The housing components are made out of synthetic materials (ABS, PMMA and PC). Thus, avoid contact with acetone, ethyl alcohol and similar detergents that contain solvents. Any splashes must be wiped off immediately.

Clean the photometer enclosure as follows:

- If the housing surface is dirty, wipe it with a soft cloth and mild soapy water.
- Remove any chemicals splashes as soon as possible.
- For disinfection, you can use isopropanol for cleaning for a short time.

5.2.2 Cleaning the cell shaft

CAUTION
The surface areas of the cell shaft are made of synthetic material (PPO/PS, PMMA). Thus, avoid contact with acetone, ethyl alcohol and similar detergents that contain solvents. Any splashes must be wiped off immediately.

Note
If a cell has broken, the cell shaft has to be cleaned immediately. To do so, proceed as described in section 6.1.

Normally, it is not required to clean the cell shaft routinely. Remove dust and slight contamination with a moist, lint free cloth. Use isopropanol briefly to remove persistent coatings (e.g. reagent remains). Especially clean the bottom parts of the lateral surfaces of the rectangular cell shaft where the light barriers for the automatic cell recognition are located.

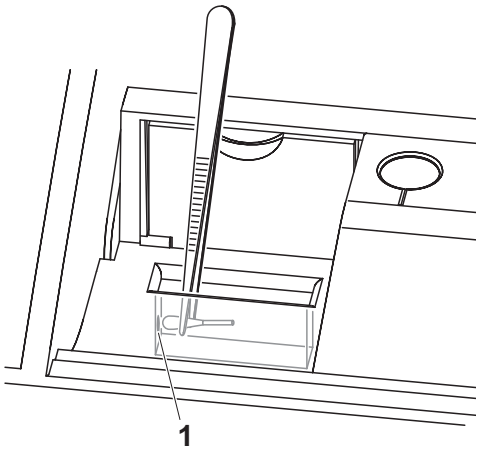
5.2.3 Cleaning the detector lens

Normally, it is not required to clean the detector lens routinely. Cleaning the detector lens can be necessary in the following cases:

- If the lens is visibly smudged, e.g. after a cell has broken or after a reagent accident (see also section 6.1 ACTIONS IN THE CASE OF A BROKEN CELL).
- If, due to environmental influences or reagent contamination, the photometer displays the message, *Wavelength calibration* during the self-test after being switched on (see section 6.2)

Note
If the lens is often smudged (error, *Wavelength calibration* during the self-test), check whether the correct operating conditions are observed. Follow the details in section 3.2 for this purpose.

Proceed as follows to clean the detector lens:



The detector lens is on the front left side of the rectangular cell shaft (pos. 1).

1 Switch off the photometer.

2 Cut off the end (approx. 2 cm) of a Dacron® swab, e.g. HY-LiTE® sampling pen, cat.no. 1.30102.0021.

3 Grasp the cut-off end with the tip of a pair of tweezers or small pliers. Clean the lens with the dry head of the swab. To do so, move the head from the center of the lens outward in circles. If there are persistent coatings, moisten the swab with a little deionized water or isopropanol.

Note
After recommissioning, carry out the photometer monitoring for all measurements (see section 4.15.2).

6 What to do if ...

6.1 Actions in the case of a broken cell

WARNING
Cells can contain dangerous substances. If the contents are released, follow the safety instructions of the package insert. If necessary, take corresponding protective measures (protective goggles, protective gloves etc.).

CAUTION
Do not turn the photometer upside down to remove the liquid!
When doing so, the liquid could come into contact with electronic components and damage the photometer.

The photometer has a drain device through which the contents of a broken cell can drain off without causing any damage.

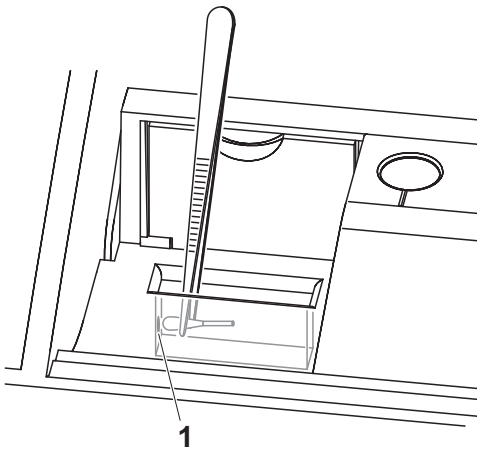
Proceeding after a cell has broken

1. Switch off the photometer and disconnect it from the power supply.
2. Let the liquid drain off into a suitable container and dispose of it properly according to the instructions of the reagent package.
3. Carefully remove all broken glass, e.g. with tweezers.
4. Carefully clean the cell shaft using a moist, lint-free cloth. If there are persistent coatings, use isopropanol for a short time. Especially clean the bottom parts of the lateral surfaces of the rectangular cell shaft, where the light barriers for the automatic cell recognition are located.
5. Let the cell shaft dry.

Note
After recommissioning, carry out the photometer monitoring for all measurements (see section 4.15.2).

If, after recommissioning, an error occurs during the wavelength calibration, the detector lens is probably smudged. In such a case, clean the lens as follows:

Cleaning the detector lens



The detector lens is on the front left side of the rectangular cell shaft (pos. 1).

1 Switch off the photometer.

2 Cut off the end (approx. 2 cm) of a Dacron® swab, e.g. HY-LiTE® sampling pen, cat.no. 1.30102.0021.

3 Grasp the cut-off end with the tip of a pair of tweezers or small pliers. Clean the lens with the dry head of the swab. To do so, move the head from the center of the lens outward in circles. If there are persistent coatings, moisten the swab with a little deionized water or isopropanol.

6.2 Error causes and remedies

Instrument does not react to keystroke

Cause	Remedy
– Operating condition undefined or EMC load unallowed	– Processor reset: Press the **<ON/OFF>** and **<ESC>** key simultaneously.

Acoustic signal on keystroke

Cause	Remedy
– The key does not have any function in the current operating state	– Press a different key

Measuring range undercut or exceeded

Cause	Remedy
– Method not suitable	– Select method with suitable measuring range – Dilute the sample

Note
In *Concentration* mode you can display the current absorbance value as an additional information (*[Setup]/Display absorbance*, see also section 4.5.6).

Self-test does not start. The instrument displays *Please remove cell*

Cause	Remedy
– A cell is inserted in one of the cell shafts	– Remove the cell – Then press the **<START ENTER>** key
– A foreign object is inserted in one of the cell shafts	– Remove foreign object – Then press the **<START ENTER>** key
– The instrument has to carry out a new adjustment for the rectangular cell recognition	– Press the **<START ENTER>** key.
– The cell shaft is contaminated	– Clean the cell shaft (see section 5.2.2 and section 6.1) – Restart the instrument – If necessary, confirm the *Please remove cell* message with **<START ENTER>**.
– Instrument defective	– Return instrument to service department

Obviously incorrect measured values

Cause	Remedy
– Cell contaminated	– Clean the cell
– Dilution set incorrectly	– Set the dilution
– Selected method not suitable	– Select different method
– Zero measurement incorrect	– Perform zero measurement
– Blank value incorrect	– Remeasure the blank value
– Cells that are not recognized (e.g. some plastic cells) disturb the AutoCheck measurement and, as a consequence, falsify measured values until the next AutoCheck is carried out	– Use suitable cells (see section 7.1 and section 8.1)

Fluctuating measured values

Cause	Remedy
– Cell shaft cover open	– Close the cell shaft cover

Self test failed.

Cause	Remedy
– *System test*: Instrument defective	– Return instrument to service department
– *Filter test*: Instrument defective	– Return instrument to service department
– *Wavelength calibration*:	
– Foreign particle in the cell shaft	– Remove foreign object
– Lens smudged	– Clean the lens (see section 5.2.3 or section 6.1). If this happens repeatedly, check the operating conditions (see section 3.2)
– Instrument defective	– Return instrument to service department

Connected printer does not print

Cause	Remedy
– Printer not suitable	– Connect a printer that can interpret the printer control language PCL-3

7 Technical data

7.1 Measurement characteristics

Measuring principle Single-beam spectrophotometer

Light source	Lamp type	Xenon flashlamp
	Average lifetime	5 x 10^8 flashes, corresponding to at least 13000 h in permanent operation

Monochromator	Type	Grating monochromator with step motor
	Wavelength range	190 - 1100 nm
	Max. scan speed	approx. 3300 nm/min
	Wavelengths calibration	Automatic
	Accuracy	± 1 nm
	Reproducibility	± 0.5 nm
	Resolution	1 nm
	Spectral band width	4 nm

Photometric measurement	Light sensor	Photo diode
	Measuring range	A = -3.300 to A = +3.300
	Linearity	< 1 % for A ≤ 2.000
	Accuracy	– 0.003 A for A < 0.600 – 0.5 % of the reading for 0.600 ≤A≤ 2.000
	Reproducibility	± 0.002 at A = 1.000
	Resolution	ΔA = 0.001
	Scattered light	< 0.1 % transmission at 340 and 408 nm

Usable cells

Round cells	– Outer diameter: 16 mm – Flat cell bottom
Rectangular cells	– Path length: 10 mm, 20 mm and 50 mm – Maximum width: 12.6 mm
Minimum filling level	20 mm
Minimum filling volume	Round cell 16 mm: 4 ml Rectangular cell, 10 mm: 2 ml Rectangular cell, 20 mm: 4 ml Rectangular cell, 50 mm: 10 ml
Cell recognition	automatic for all Spectroquant® cell tests and reagent tests

Warm-up time

At least 15 min for single measurements
2 h for kinetic measurements with the highest possible precision

Note
Changes or modifications not expressly approved by the manufacturer could void the user's authority to operate the equipment.

Measuring modes

- Concentration
  - Measurement with permanently programmed methods, adjusted to the Spectroquant® test set program
  - Automatic method selection if test sets with barcodes are used
  - Program support for the creation of additional user-defined methods (max. 100)
  - Citation forms and units method dependent
  - Display of the absorbance value can be added
  - Method data update possible via Internet
- Absorbance / % Transmission
  - Measurement against own reference absorbance value possible
- Multi wavelengths
  - Freely definable calculations from up to four individual absorbance values at different wavelengths
  - Calculations can be stored as methods (max. 50)
- Spectrum
  - Absorbance or % transmission mode
  - Limits freely selectable within the wavelength range
  - Increment: 1 nm
  - Recording duration for the complete wavelength range: < 7 min
  - Settings can be stored as profiles (max. 20)
  - Evaluation functions: Cursor scanning, zoom, min./max. recognition, peak area determination, derivation, smoothing, multiplication by constants, addition of constants, addition and subtraction of spectra, formation of the quotient of two spectra
- Kinetics
  - Absorbance or % transmission mode
  - Minimal adjustable scan interval: 1 s (if the absorbance of the test sample is high, the scan interval is extended due to the longer duration of the individual measurements)
  - Settings can be stored as profiles (max. 20)
  - Evaluation functions: Cursor scanning, zoom, min./max. determination, slope calculation (for an interval or total), enzymatic activity

7.2 Measured value documentation and quality assurance

Memory for measured values	Memory capacity	– 1000 single measured values from the measuring modes, concentration, absorbance / % transmission and multi wavelengths – 4 MByte internal memory, sufficient for approx. 100 spectra and 400 kinetic curves (sample values based on the following assumptions: All spectra over a wavelength range of 600 nm and all kinetic curves with 150 single values each)
	Output options	USB memory device, printer, PC
	File formats	ASCII, *.csv
Monitoring functions	AQA1	Check of the photometer
	AQA2	Check of the total system
	AQA3	Check of the sample matrix
User management	Can be switched off	yes
	User accounts	3 hierarchical levels (administrator, user, guest)
	Password protection	for administrators and users

7.3 General meter data

Dimensions 404 x 197 x 314 mm (width x height x depth)

Weight approx. 4.5 kg (without plug-in power supply)

Housing type of protection IP 30

Electrical protective class III

Test mark CE, cETLus

Allowed environmental conditions

Temperature	Operation:	+10 °C to + 35 °C (41 °F to 95 °F)
	Storage:	-25 °C to + 65 °C (-13 °F to 268 °F)
Humidity	Yearly mean:	≤ 75 %
	30 days/year:	95 %
	Other days:	85%
Climatic class	2	

Power supply

Power pack	Type: FRIWO FW 7530/12 Input: 100 - 240 V ~ / 50 - 60 Hz / 0.650 A Output: 12 V = / 2.5 A Length of the connection cable to the photometer: 2.0 m (In compliance with Eco-design directive 2009/125/EG, EuP step 2)

Guidelines and norms used are defined in a separate document: Declaration of Conformity

Communication interfaces

RS232	1 x 9-pin D-sub
USB	– 1 x USB-A (for printer, USB memory devices, keyboard or bar code reader) – 1 x USB-B (for PC)

Other features

- Drain for spilled cell contents
- Photometer software update and method data update possible via Internet

Available languages

- German (Englisch)
- English
- Français
- Español
- Italiano
- Bulgarian/Български
- Česko
- Simplified Chinese/ 中文 *
- Traditional Chinese/ 繁體中文 *
- Greek/Ελληνικά
- Indonesian/Indonesia
- Japanese/ 日本語
- Magyar
- Malay/Melayu
- Norsk
- Polski
- Portuguése
- Russian/Русский
- Slovenščina
- Thai/ ภาษาไทย *
- Turkish/Turkce
- Dansk
- Română
- Nederlands

* These languages require additional character sets (for details, see section 4.20.3 LANGUAGE UPDATE)

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.

8 Accessories and options

8.1 Accessories

Cells for the Spectroquant® test set program

Description	Order no.
Empty round cells Ø 16 mm (1 pack = 25 cells)	1.14724.0001
Rectangular cell, 10 mm (1 pack = 2 cells)	1.14946.0001
Rectangular cell, 20 mm (1 pack = 2 cells)	1.14947.0001
Rectangular cell, 50 mm (1 pack = 2 cells)	1.14944.0001
Rectangular cell, quartz, 10 mm (1 pack = 2 cells)	1.00784.0001
Half micro cell, 50 mm (1 pack = 2 cells)	1.73502.0001
Positioning Aid for 10 mm plastic cells Spectroquant®	1.00787.0001

Case and cable for mobile use

Description	Order no.
Case for Spectroquant® Pharo 300	1.00670.0001
12 V-Adapter for Spectroquant® Pharo 300 (Auto/PowerPack)	1.00786.0001

Application packages

Description	Order no.
Supplementary Software for the Brewery Industry (German/Englisch)	1.00703.0001

8.2 Test equipment

Test equipment for instrument check (AQA1)

Description	Order no.
Spectroquant® PhotoCheck	1.14693.0001
CertiPUR® UV/VIS-Standard 1 - potassium dichromate solution to check the absorption according to DAB and Ph.Eur.	1.08160.0001
CertiPUR® UV/VIS-Standard 1 A - potassium dichromate solution to check the absorption at 430 nm according to DAB and Ph.Eur.	1.04660.0001
CertiPUR® UV/VIS-Standard 2 - sodium nitrite solution to check the scattered light according to DAB and Ph.Eur.	1.08161.0001
CertiPUR® UV/VIS-Standard 3 - sodium jodide solution to check the scattered light according to DAB and Ph.Eur.	1.08163.0001
CertiPUR® UV/VIS-Standard 6 - holmium oxide solution; reference material for the wavelength according to DAB and Ph.Eur.	1.08166.0001

Test equipment for system check (AQA2) and Matrix-Check (AQA3)

Spectroquant® CombiCheck or CertiPUR® standard solutions are listed in the Merck catalog and on the Internet under www.analytical-test-kits.com.

Test equipment for pipette volume

Description	Order no.
Spectroquant® PipeCheck	1.14962.0001

8.3 Optional equipment

The following optional extensions are available in specialist shops:

- USB barcode reader (hand scanner)
- USB PC keyboard

8.4 Connection cable:

PC

You can connect a PC to the Spectroquant® Pharo 300 in one of the following ways:

Description	Order no.
– Cable with USB-B and USB-A plug	Specialist shops
– Zero modem cable 9-pin (D-sub socket) - 9-pin (D-sub socket)	Specialist shops

USB printer

You can connect a USB printer to the Spectroquant® Pharo 300:

Description	Order no.
– Cable with USB-B and USB-A plug	Specialist shops

Needle printer

Suitable printers and cables are available on request.

Appendix

A.1 Menus

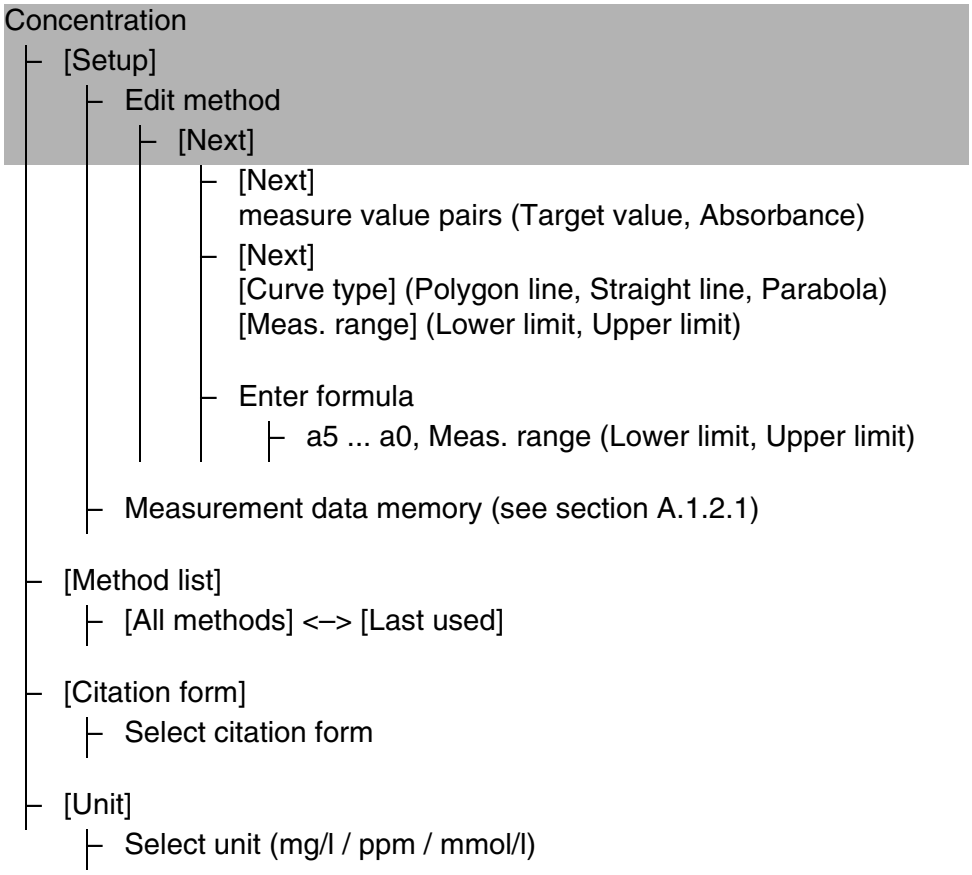
Measuring (see section A.1.1)
General settings and functions (see section A.1.2)

A.1.1 Measuring

- Concentration (see section A.1.1.1)
- Absorbance / % Transmission (see section A.1.1.2)
- Special / Multi wavelengths
- Spectrum
- Kinetics

A.1.1.1 *Concentration*

Concentration
- [Setup]
  - Dilution
    - Sample + distilled water
  - Sample blank value
  - User-defined blank value (✓)
  - Turbidity correction (✓)
  - Display absorbance (✓)
  - AQA (see section A.1.2.2)
  - Edit method (see New method)
  - New method
    - Number, Designation, Version, Wavelength, Cell, Citation form, Unit, Resolution, Calibration curve
    - [Method list]
      - All methods <–> Last used
    - [Delete]
    - [Next]
      - Standard ID
      - Standard manufacturer


Concentration
[Setup]
Edit method
[Next]
[Next]
measure value pairs (Target value, Absorbance)
[Next]
[Curve type] (Polygon line, Straight line, Parabola)
[Meas. range] (Lower limit, Upper limit)
Enter formula
a5 ... a0, Meas. range (Lower limit, Upper limit)
Measurement data memory (see section A.1.2.1)
[Method list]
[All methods] <–> [Last used]
[Citation form]
Select citation form
[Unit]
Select unit (mg/l / ppm / mmol/l)

A.1.1.2 *Absorbance / % Transmission*

Absorbance / % Transmission
- [Setup]
  - AQA (see section A.1.2.2)
  - Measurement data memory (see section A.1.2.1)
- [Wavelength]
  - Set new wavelength (nm)
- [Transmission] <–> [Absorbance]
- [Reference]
  - Reference absorbance

A.1.1.3 *Special / Multi wavelengths*

Special / Multi wavelengths
- [Setup]
  - New method
    - Number, Name, Version, Citation form, Unit, Resolution, Cell
    - [Method list]
      - [All methods] <–> [Last used]
    - [Delete]
    - [Next]
      - Wavelength 1 ... 10, a0 ... a10, b0 ... b10, Function
  - Edit method (see New method)
  - Measurement data memory (see section A.1.2.1)
  - AQA (see section A.1.2.2)
- [Method list]
  - [All methods] <–> [Last used]
- [Transmission] <–> [Absorbance]

A.1.1.4 *Spectrum*

- Spectrum
  - [Setup]
    - Wavelength start
    - Wavelength stop
    - Mode
      - Absorbance
      - Transmission
    - Smoothing
      - Yes
      - No
    - Scaling
      - Auto
      - Manual
    - Y-axis min
    - Y-axis max
  - [Edit]
    - Extreme values (zoomed area)
    - Mark points
    - Delete all marks
    - Original values
    - Integral
    - Derivative
    - Compare spectrum
    - Add spectrum
    - Subtract spectrum
    - Divide spectrum (ratio)
    - Add fixed value
    - Multiply fixed value
  - [Zoom]
    - [Original]
    - [xy_max]
  - [Open]

A.1.1.5 *Kinetics*

Kinetics
- [Setup]
  - New profile
  - Edit profile
  - Scaling
    - Auto
    - Manual
  - Y-axis min
  - Y-axis max
- [Profile list]
  - [All profiles] <–> [Last used]
- [Edit]
  - Slope & catalytic activity
  - Compare spectrum
  - Subtract spectrum
- [Open]

A.1.2 General settings and functions

- [General setup] (see section A.1.2.1)
- [Logout]
- [AQA] (see section A.1.2.2)
- [Info]

A.1.2.1 *General setup*

- [General setup]
  - Language
  - Date/Time
    - Date
    - Time
  - Display settings
    - Contrast [%]
  - User management
    - [Setup]
      - Deactivate user management
      - Change password
    - [Add]
    - [Delete]
    - [Change]
  - Measured value memory
    - [Setup]
      - AutoStore (✓)
      - Filter
        - Mode
          - Absorbance / Transmission
          - Concentration
          - Multi wavelength
        - User
        - ID
        - Date
          - from ... to ...
        - [Reset entry]
        - [Reset all]
      - Selected values: invert selection (✓)
      - Delete memory (selected values only)
      - Delete memory (all values)
    - [Single value] <–> [List]
    - [Delete]

- [General setup]
  - Software/methods update
    - USB memory device
    - PC
    - Cancel
  - Reset
    - Reset configuration
    - Delivery condition
  - Data transfer/Printer
    - Decimal separator for csv-Files
      - Point (12.34)
      - Comma (12,34)
    - Data format (print)
      - Short
      - Extended
    - Baudrate for RS232 printer (1200 ... 19200)
  - Exchange methods/profiles
  - Save data to USB memory device
  - Unlock application packages

A.1.2.2 *AQA*

- [AQA]
  - AQA1 setup
    - Mode
      - AQA1 inactive
      - Weeks
    - Interval
    - Lock instrument (No/Yes)
    - Configuration of tests ...
      - PhotoCheck
      - CertiPUR UV-VIS 1 ...
  - AQA2 setup
    - Mode
      - AQA2 inactive
      - Weeks
      - Measurements
    - Lock methods (No/Yes)
    - Method...
      - [All methods] <–> [Last used]
      - Method
      - AQA2
      - Interval
      - Target value
      - Tolerance
      - Standard ID
  - AQA3/MatrixCheck setup
    - Maximum difference
  - AQA1 check
  - AQA2 check
    - [All methods] <–> [Last used]
  - AQA3/MatrixCheck
  - AQA1 info
  - AQA2 info

A.2 Glossary

Absorbance Logarithmic dimension for the absorption of the sample; negative decadal logarithm of the transmission.

Analysis instructions The exact proceeding to carry out the detection procedure is described in the analysis instructions.

AQA Analytical Quality Assurance.

AQA labeling In the documentation, measured values are given an AQA labeling (AQA1 or AQA2), depending on whether or not the measurement was carried out with AQA and with which AQA level.

AQA1 1st step of the analytical quality assurance:
Monitoring of the instrument.

AQA2 2nd step of the analytical quality assurance:
Monitoring of the total system.

AQA3 3rd step of the analytical quality assurance:
Check of whether the photometric determination is disturbed by other sample ingredients (sample matrix).
The MatrixCheck can be carried out by spiking or diluting:

AutoSelector Plastic cylinder with bar code. It is inserted in the round cell shaft and transmits the code for a reagent test set to the photometer.

Bar code Optical code (black and white bars) of the method that can be read by light barriers in the photometer.

Baseline Reference value for the spectrum of reference absorbances or reference transmissions.

Cell Vessel to take a liquid sample for measurement in a photometer.
The cell material (mostly glass) must have certain optical features to be suitable for photometry.

Citation forms Different forms of representing a measured concentration value that can be derived from each other.
The method for the determination of phosphate, e.g. supplies a measured value for phosphorous P. This measured value can alternatively be given in the citation forms PO4, PO4-P or P2O5.

CombiCheck Multiparameter standards used to check the total system for a method.

Concentration Mass or amount of a dissolved substance per volume, e.g. in g/l or mol/l.

Correlation coefficient Specifies the extent of the linear relationship of value pairs when determining the zero point and slope for a user-defined method.

Detection procedure The detection procedure designates the general principle of how a sample is brought into a form suitable for measurement.
Different methods can be based on the same detection procedure.

Kinetics Measurement over a period of time.

MatrixCheck see AQA3.

Measured value The measured value is the special value of a measured parameter to be determined. It is given as a combination of the numerical value and unit (e.g. 3 m; 0.5 s; 5.2 A; 373.15 K).

Method A method comprises a chemical detection procedure and special method data (calibration line) that is required to evaluate the measurement results.
How to carry out the method up to measuring with the photometer is described in the analysis instructions.
The Spectroquant® Pharo 300 contains a database with methods. Furthermore, user-defined methods can be entered in the database as well.

PhotoCheck standard Stable color solution with defined absorbance values for the check of the photometer.

Reagent blank value The evaluation of the photometric measurement always refers to the comparison value of a test sample without the substance to be determined (reagent blank value). Thus the influence of the basic absorbance of the reagents on photometric measurement is compensated for.
For all measurements with Spectroquant® test sets (concentration mode) there is an exactly determined reagent blank value stored in the photometer. This value can, however, be overwritten by a reagent blank value measured by yourself.

Recovery The recovery rate is the found measured value divided by the default value (percentage).
Example: Default value 20 mg/l; Found 19.7 mg/l => recovery 0.985 or recovery rate 98.5%.

Reference absorbance With the reference absorbance, the basic absorbance stored in the photometer can be replaced by a measurement of your own.

Reset Restoring the original condition of all settings of a measuring system.

Sample blank value The sample blank value is a characteristic of the sample (coloration) to be currently determined. It is diluted according to the used method but does not contain any color reagents.
The pH value corresponds to that of the test sample.

Spectrum Distribution of the intensity, transmission or absorbance depending on the wavelength.

Standard Sample with a defined concentration of the analyte to be determined.

Test sample Designation of the test sample ready to be measured. Normally, a test sample is made by processing the original sample. The test sample and original sample are identical if the test sample was not processed.

Test set (test) A test set contains all reagents that are required for the photometric determination of the sample according to the analysis instructions.

Transmission Part of the light that goes through the sample.

Turbidity Light attenuation caused by diffuse scattering at undissolved substances.

Zero adjustment Adjusting a photometer with a water-filled cell.

A.3 List of trademarks

Trademark	Owner
CertiPUR®	Merck KGaA
Microsoft®	Microsoft Corporation
Spectroquant®	Merck KGaA
Windows®	Microsoft Corporation

A.4 Index

U

W

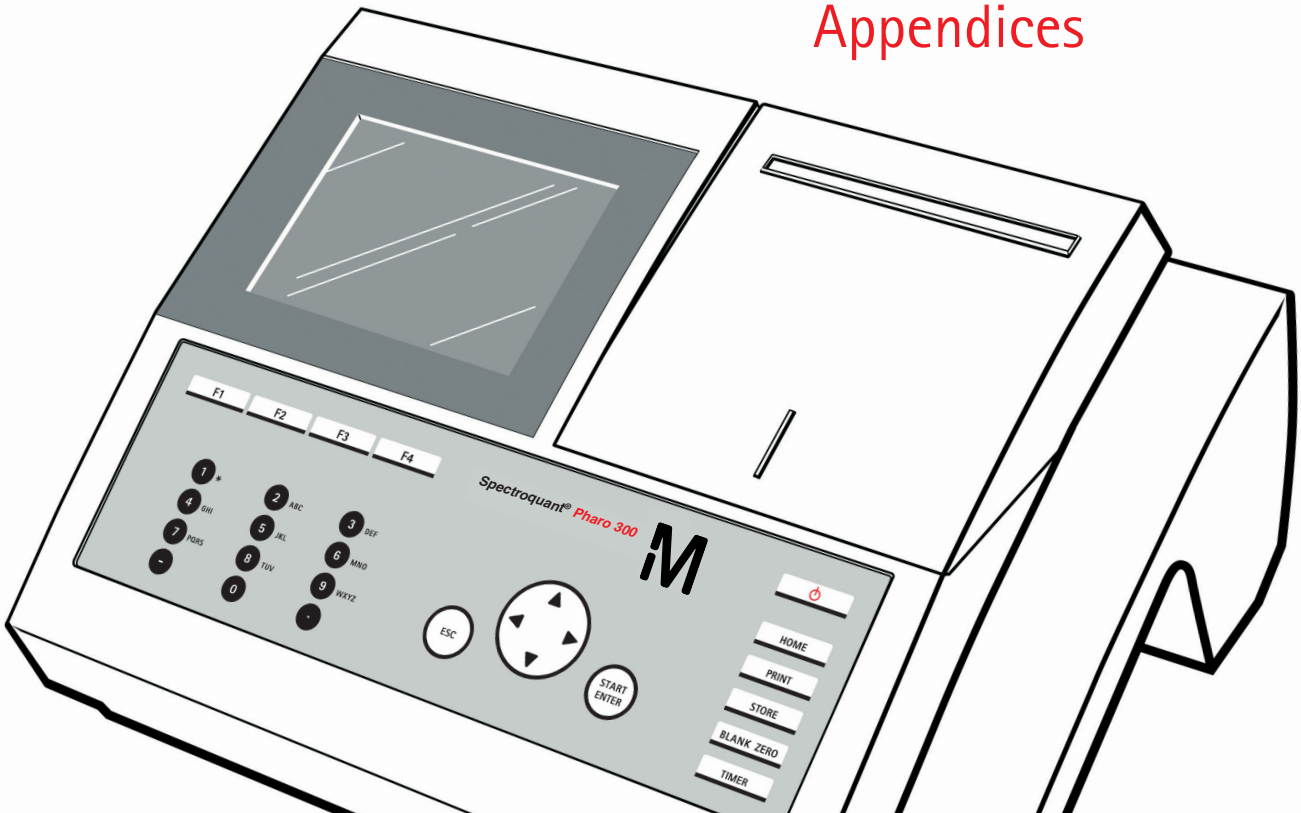
Z

eng

Spectroquant® UV/VIS Spectrophotometer

Pharo 300

Analytical Procedures
Appendices



Contents

Available photometric test kits

The following methods with the corresponding method numbers are programmed into the photometer and measurements can be made without any further adjustments. Method selection is achieved through a barcode on the cell (for cell tests) or through a barcode on the AutoSelector (for reagent tests).
The method number listed in column 1 is for manual selection. The total range relates to the cited test in column 2 and, in the reagent tests, covers all possible path length (cells from 10 to 50 mm).

Method No.	Determination		Total Range	Method
208	Acid Capacity Cell Test to pH 4.3 (total alkalinity)	101758	0.40 – 8.00 mmol/l	Indicator reaction
2518	ADMI	ADMI	2.0 – 100.0	Inherent color
2517	ADMI	ADMI	10 – 500	Inherent color
196	Aluminium Cell Test*	100594	0.02 – 0.50 mg/l Al	Chromazurole S
043	Aluminium Test*	114825	0.020 – 1.20 mg/l Al	Chromazurole S
2522	Ammonia, free	NH_3	0.000 – 0.730 mg/l NH_3	as ammonium
2521	Ammonia, free	NH_3	0.00 – 1.83 mg/l NH_3	as ammonium
2520	Ammonia, free	NH_3	0.00 – 3.65 mg/l NH_3	as ammonium
104	Ammonium Cell Test	114739	0.010 – 2.000 mg/l NH_4-N	Indophenol blue
051	Ammonium Cell Test	114558	0.20 – 8.00 mg/l NH_4-N	Indophenol blue
052	Ammonium Cell Test	114544	0.5 – 16.0 mg/l NH_4-N	Indophenol blue
053	Ammonium Cell Test	114559	4.0 – 80.0 mg/l NH_4-N	Indophenol blue
054	Ammonium Test	114752	0.010 – 3.00 mg/l NH_4-N	Indophenol blue
155	Ammonium Test	100683	2.0 – 75.0 mg/l NH_4-N	Indophenol blue
163	Ammonium Test	100683	5 – 150 mg/l NH_4-N	Indophenol blue
130	Antimony in water and wastewater	Sb	0.10 – 8.00 mg/l Sb	Brilliant green
156	AOX Cell Test*	100675	0.05 – 2.50 mg/L AOX	Oxidation to chloride
132	Arsenic Test*	101747	0.001 – 0.100 mg/l As	Ag-DDTC
157	BOD Cell Test*	100687	0.5 – 3000 mg/l BOD	Modification of Winkler method
164	Boron Cell Test*	100826	0.05 – 2.00 mg/l B	Azomethine H
046	Boron Test*	114839	0.050 – 0.800 mg/l B	Rosocyanine
195	Bromate in water and drinking water	BrO_3	0.003 – 0.120 mg/l BrO_3	3,3'-Dimethylnaphtidine
146	Bromine Test*	100605	0.020 – 10.00 mg/l Br_2	S-DPD
067	Cadmium Cell Test	114834	0.025 – 1.000 mg/l Cd	Cadion derivative
183	Cadmium Test	101745	0.0020 – 0.500 mg/l Cd	Cadion derivative
165	Calcium Cell Test*	100858	10 – 250 mg/l Ca	Phthalein purple
042	Calcium Test*	114815	5 – 160 mg/l Ca	Glyoxal-bis-hydroxyanil
125	Calcium Test sensitive*	114815	1.0 – 15.0 mg/l Ca	Glyoxal-bis-hydroxyanil
304	Calcium Test**	100049	0.20 – 4.00 mg/l Ca	Phthalein derivative
095	Chloride Cell Test*	114730	5 – 125 mg/l Cl	Iron(III)-thiocyanat
110	Chloride Test*	114897	2.5 – 25.0 mg/l Cl	Iron(III)-thiocyanat
063	Chloride Test*	114897	10 – 250 mg/l Cl	Iron(III)-thiocyanat
218	Chloride Cell Test*	101804	0.5 – 15.0 mg/l Cl	Iron(III)-thiocyanat
219	Chloride Test*	101807	0.10 – 5.00 mg/l Cl	Iron(III)-thiocyanat
141	Chlorine Cell Test* (free chlorine)	100595	0.03 – 6.00 mg/l Cl_2	S-DPD
142	Chlorine Cell Test* (free and total chlorine)	100597	0.03 – 6.00 mg/l Cl_2	S-DPD
143	Chlorine Test* (free chlorine)	100598	0.010 – 6.00 mg/l Cl_2	S-DPD
145	Chlorine Test* (total chlorine)	100602	0.010 – 6.00 mg/l Cl_2	S-DPD
144	Chlorine Test* (free and total chlorine)	100599	0.010 – 6.00 mg/l Cl_2	S-DPD
194	Chlorine Cell Test*, Test* (free and total chlorine)	Cl_2_l	0.010 – 6.00 mg/l Cl_2	DPD
149	Chlorine dioxide Test*	100608	0.020 – 10.00 mg/l ClO_2	S-DPD
2509	Chlorophyll-a (DIN/ISO)	Chl-a DIN 10	result in µg/l Chl-a	Inherent color
2510	Chlorophyll-a (DIN/ISO)	Chl-a DIN 20	result in µg/l Chl-a	Inherent color
2511	Chlorophyll-a (DIN/ISO)	Chl-a DIN 50	result in µg/l Chl-a	Inherent color
2504	Chlorophyll-a (APHA/ASTM)	Chl-a ASTM 10	result in mg/m³ Chl-a	Inherent color
2505	Chlorophyll-a (APHA/ASTM)	Chl-a ASTM 20	result in mg/m³ Chl-a	Inherent color
2506	Chlorophyll-a (APHA/ASTM)	Chl-a ASTM 50	result in mg/m³ Chl-a	Inherent color
2507	Chlorophyll-a, -b, -c (APHA/ASTM)	Chl a, b, c 10	result in mg/m³ Chl-a, -b, -c	Inherent color
2508	Chlorophyll-a, -b, -c (APHA/ASTM)	Chl a, b, c 50	result in mg/m³ Chl-a, -b, -c	Inherent color
039	Chromate Cell Test*	114552	0.05 – 2.00 mg/l Cr	Diphenylcarbazide
039	Chromate Cell Test* (total chromium)	114552	0.05 – 2.00 mg/l Cr	Peroxodisulfate oxidation, diphenylcarbazide
040	Chromate Test*	114758	0.010 – 3.00 mg/l Cr	Diphenylcarbazide
020	Chromium Baths	Cr-bath	4.0 – 400 g/l CrO_3	Inherent color
305	Cobalt in water	Co	0.5 – 10.0 mg/l Co	Nitroso-R salt
031	COD Cell Test*	114560	4.0 – 40.0 mg/l COD	Chromosulfuric acid oxidation, chromate determination

* turbidity correction possible
** individual calibration necessary

Available photometric test kits

Method No.	Determination		Total Range	Method
211	COD Cell Test*	101796	5.0 – 80.0 mg/l COD	Chromosulfuric acid oxidation, chromate determination
014	COD Cell Test*	114540	10 – 150 mg/l COD	Chromosulfuric acid oxidation, chromate determination
105	COD Cell Test*	114895	15 – 300 mg/l COD	Chromosulfuric acid oxidation, chromate determination
093	COD Cell Test*	114690	50 – 500 mg/l COD	Chromosulfuric acid oxidation, chromate determination
023	COD Cell Test*	114541	25 – 1500 mg/l COD	Chromosulfuric acid oxidation, chromium(III) determination
094	COD Cell Test*	114691	300 – 3500 mg/l COD	Chromosulfuric acid oxidation, chromium(III) determination
024	COD Cell Test*	114555	500 – 10000 mg/l COD	Chromosulfuric acid oxidation, chromium(III) determination
210	COD Cell Test*	101797	5000 – 90000 mg/l COD	Chromosulfuric acid oxidation, chromium(III) determination
137	COD Cell Test (Hg free)*	109772	10 – 150 mg/l COD	Chromosulfuric acid oxidation, chromate determination
138	COD Cell Test (Hg free)*	109773	100 – 1500 mg/l COD	Chromosulfuric acid oxidation, chromium(III) determination
220	COD Cell Test for seawater*	117058	5.0 – 60.0 mg/l COD	Chloride depletion, chromosulfuric acid oxidation, chromate determination
221	COD Cell Test for seawater*	117059	50 – 3000 mg/l COD	Chloride depletion, chromosulfuric acid oxidation, chromium(III) determination
015	Color α(436) (spectral absorption coefficient)	Color436	0.1 – 250 m^{-1}	Measurement at 436 nm
061	Color α(525) (spectral absorption coefficient)	Color525	0.1 – 250 m^{-1}	Measurement at 525 nm
078	Color α(620) (spectral absorption coefficient)	Color620	0.1 – 250 m^{-1}	Measurement at 620 nm
303	Color (410) (EN 7887)	CU410	2 – 2500 mg/l Pt	Measurement at 410 nm
032	Color Hazen*	CU340	0.2 – 500 mg/l Pt/Co (Hazen)	Platinum-cobalt-Standard Method, measurement at 340 nm
179	Color Hazen*	CU445	1 – 1000 mg/l Pt/Co (Hazen)	Platinum-cobalt-Standard Method, measurement at 445 nm
180	Color Hazen*	CU455	1 – 1000 mg/l Pt/Co (Hazen)	Platinum-cobalt-Standard Method, measurement at 455 nm
181	Color Hazen*	CU465	1 – 1000 mg/l Pt/Co (Hazen)	Platinum-cobalt-Standard Method, measurement at 465 nm
026	Copper Cell Test*	114553	0.05 – 8.00 mg/l Cu	Cuprizone
027	Copper Test*	114767	0.02 – 6.00 mg/l Cu	Cuprizone
083	Copper Baths	Cu-bath	2.0 – 80.0 g/l Cu	Inherent color
228	Cyanide Cell Test* (free cyanide)	102531	0.010 – 0.500 mg/l CN	Barbituric acid and pyridinecarboxylic acid
075	Cyanide Cell Test* (free cyanide)	114561	0.010 – 0.500 mg/l CN	Barbituric acid and pyridinecarboxylic acid
075	Cyanide Cell Test* (readily liberated cyanide)	114561	0.010 – 0.500 mg/l CN	Citric acid, barbituric acid, and pyridinecarboxylic acid
109	Cyanide Test* (free cyanide)	109701	0.0020 – 0.500 mg/l CN	Barbituric acid and pyridinecarboxylic acid
109	Cyanide Test* (readily liberated cyanide)	109701	0.0020 – 0.500 mg/l CN	Citric acid, barbituric acid, and pyridinecarboxylic acid
210	Cyanuric Acid Test	119253	2 – 160 mg/l Cyan Acid	Triazine derivative
076	Fluoride Cell Test*	114557	0.10 – 1.50 mg/l F	Alizarin complexone
124	Fluorid Cell Test sensitive	114557	0.025 – 0.500 mg/l F	Alizarin complexone
215	Fluoride Cell Test*	100809	0.10 – 1.80 mg/l F	Alizarin complexone
216	Fluorid Cell Test sensitive	100809	0.025 – 0.500 mg/l F	Alizarin complexone
166	Fluorid Test*	114598	0.10 – 2.00 mg/l F	Alizarin complexone
167	Fluorid Test*	114598	1.0 – 20.0 mg/l F	Alizarin complexone
217	Fluorid Test	100822	0.02 – 2.00 mg/l F	SPADNS
028	Formaldehyde Cell Test*	114500	0.10 – 8.00 mg/l HCHO	Chromotropic acid
091	Formaldehyde Test*	114678	0.02 – 8.00 mg/l HCHO	Chromotropic acid
045	Gold Test	114821	0.5 – 12.0 mg/l Au	Rhodamine B
	Hardness see Total Hardness or Residual Hardness			
	Hazen see Color Hazen			
044	Hydrazine Test*	109711	0.005 – 2.00 mg/l N_2H_4	4-Dimethylaminobenzaldehyde
099	Hydrogenperoxide Cell Test*	114731	2.0 – 20.0 mg/l H_2O_2	Titanyl sulfate

* turbidity correction possible
** individual calibration necessary

Available photometric test kits

Method No.	Determination		Total Range	Method
128	Hydrogenperoxide Cell Test sens.*	114731	0.25 – 5.00 mg/l H_2O_2	Titanyl sulfate
198	Hydrogenperoxide Test	118789	0.015 – 6.00 mg/l H_2O_2	Phenanthroline derivative
147	Iodine Test*	100606	0.050 – 10.00 mg/l I_2	S-DPD
033	Iodine color number	IodFa	0.010 – 3.00	Measurement at 340 nm
021	Iodine color number	IodFa	0.2 – 50.0	Measurement at 445 nm
037	Iron Cell Test	114549	0.05 – 4.00 mg/l Fe	Triazine
106	Iron Cell Test*	114896 (Fe(II) and Fe(III))	1.0 – 50.0 mg/l Fe	2,2'-Dipyridyl
038	Iron Test	114761	0.005 – 5.00 mg/l Fe	Triazine
161	Iron Test*	100796 (Fe(II) and Fe(III))	0.010 – 5.00 mg/l Fe	1,10-Phenanthroline
066	Lead Cell Test*	114833	0.10 – 5.00 mg/l Pb	PAR
160	Lead Test*	109717	0.010 – 5.00 mg/l Pb	PAR
158	Magnesium Cell Test*	100815	5.0 – 75.0 mg/l Mg	Phthalein purple
159	Manganese Cell Test*	100816	0.10 – 5.00 mg/l Mn	Formaldoxime
184	Manganese Test*	101739	0.005 – 2.00 mg/l Mn	PAN
019	Manganese Test*	114770	0.010 – 10.00 mg/l Mn	Formaldoxime
226	Manganese Test*	101846	0.005 – 2.00 mg/l Mn	PAN
135	Mercury in water and wastewater	Hg	0.025 – 1.000 mg/l Hg	Michler's ketone
175	Molybdenum Cell Test	100860	0.02 – 1.00 mg/l Mo	Bromopyrogallol red
206	Molybdenum Test	119252	0.5 – 45.0 mg/l Mo	Mercaptoacetic acid
185	Monochloramine Test	101632	0.050 – 10.00 mg/l Cl_2	Indophenol blue
017	Nickel Cell Test*	114554	0.10 – 6.00 mg/l Ni	Dimethylglyoxime
018	Nickel Test*	114785	0.02 – 5.00 mg/l Ni	Dimethylglyoxime
057	Nickel Baths	Ni-bath	2.0 – 120 g/l Ni	Inherent color
059	Nitrate Cell Test*	114542	0.5 – 18.0 mg/l NO_3-N	Nitrospectral
030	Nitrate Cell Test*	114563	0.5 – 25.0 mg/l NO_3-N	2,6-Dimethylphenol
107	Nitrate Cell Test*	114764	1.0 – 50.0 mg/l NO_3-N	2,6-Dimethylphenol
151	Nitrate Cell Test*	100614	23 – 225 mg/l NO_3-N	2,6-Dimethylphenol
060	Nitrate Test*	114773	0.2 – 20.0 mg/l NO_3-N	Nitrospectral
139	Nitrate Test*	109713	0.10 – 25.0 mg/l NO_3-N	2,6-Dimethylphenol
072	Nitrate Cell Test in seawater*	114556	0.10 – 3.00 mg/l NO_3-N	Resorcine
140	Nitrate Test in seawater*	114942	0.2 – 17.0 mg/l NO_3-N	Resorcine
227	Nitrate Test	101842	0.3 – 30.0 mg/l NO_3-N	Benzoic acid derivative
2503	Nitrate (UV)	NO_3	0.0 – 7.0 mg/l NO_3-N	direct measurement in the UV range
035	Nitrite Cell Test*	114547	0.010 – 0.700 mg/l NO_2-N	Griess reaction
197	Nitrite Cell Test*	100609	1.0 – 90.0 mg/l NO_2-N	Iron(II) ethylenediammonium sulfate
036	Nitrite Test*	114776	0.002 – 1.00 mg/l NO_2-N	Griess reaction
068	Nitrogen (total) Cell Test	114537	0.5 – 15.0 mg/l N	Peroxodisulfate oxidation, nitrospectral
153	Nitrogen (total) Cell Test*	100613	0.5 – 15.0 mg/l N	Peroxodisulfate oxidation, 2,6-dimethylphenol
108	Nitrogen (total) Cell Test	114763	10 – 150 mg/l N	Peroxodisulfate oxidation, 2,6-dimethylphenol
092	Oxygen Cell Test*	114694	0.5 – 12.0 mg/l O_2	Modification of Winkler method
207	Oxygen Scavengers Test	119251	0.020 – 0.500 mg/l DEHA	FerroZine®
148	Ozone Test*	100607	0.010 – 4.00 mg/l O_3	S-DPD
133	Palladium in water and wastewater	Pd	0.05 – 1.25 mg/l Pd	Thio-Michler's ketone
186	pH Cell Test	101744	6.4 – 8.8	Phenol red
	Phaeophytin-a (DIN/ISO) / (APHA/ASTM) see Chlorophyll-a (DIN/ISO) or (APHA/ASTM)			
073	Phenol Cell Test*	114551	0.10 – 2.50 mg/l Phenole	MBTH
176	Phenol Test*	100856	0.025 – 5.00 mg/l C_6H_5OH	Aminoantipyrine
177	Phenol Test*	100856	0.002 – 0.200 mg/l C_6H_5OH	Aminoantipyrine, by extraction
212	Phosphate Cell Test	100474	0.05 – 5.00 mg/l PO_4-P	Phosphomolybdenum blue
055	Phosphate Cell Test	114543	0.05 – 5.00 mg/l PO_4-P	Phosphomolybdenum blue
055	Phosphate Cell Test (total phosphorus)	114543	0.05 – 5.00 mg/l P	Peroxodisulfate oxidation, phosphomolybdenum blue
213	Phosphate Cell Test	100475	0.5 – 25.0 mg/l PO_4-P	Phosphomolybdenum blue
086	Phosphate Cell Test	114729	0.5 – 25.0 mg/l PO_4-P	Phosphomolybdenum blue
086	Phosphate Cell Test (total phosphorus)	114729	0.5 – 25.0 mg/l P	Peroxodisulfate oxidation, phosphomolybdenum blue
152	Phosphate Cell Test	100616	3.0 – 100.0 mg/l PO_4-P	Phosphomolybdenum blue
214	Phosphate Cell Test	100673	3.0 – 100.0 mg/l PO_4-P	Phosphomolybdenum blue
214	Phosphate Cell Test (total phosphorus)	100673	3.0 – 100.0 mg/l P	Peroxodisulfate oxidation, phosphomolybdenum blue
056	Phosphate Test	114848	0.010 – 5.00 mg/l PO_4-P	Phosphomolybdenum blue
162	Phosphate Test	100798	1.0 – 100.0 mg/l PO_4-P	Phosphomolybdenum blue
069	Phosphate Cell Test*	114546	0.5 – 25.0 mg/l PO_4-P	Vanadatomolybdate
070	Phosphate Test*	114842	0.5 – 30.0 mg/l PO_4-P	Vanadatomolybdate
134	Platinium in water and wastewater	Pt	0.10 – 1.25 mg/l Pt	o-Phenylendiamine

* turbidity correction possible
** individual calibration necessary

Available photometric test kits

Method No.	Determination		Total Range	Method
103	Potassium Cell Test	114562	5.0 – 50.0 mg/l K	Kalignost, turbidimetric
150	Potassium Cell Test	100615	30 – 300 mg/l K	Kalignost, turbidimetric
098	Residual Hardness Cell Test*	114683	0.50 – 5.00 mg/l Ca	Phthalein purple
079	Silicate (Silicic acid) Test	114794	0.11 – 10.70 mg/l SiO_2	Silicomolybdenum blue
081	Silicate (Silicic acid) Test	114794	0.011 – 1.600 mg/l SiO_2	Silicomolybdenum blue
169	Silicate (Silicic acid) Test*	100857	1.1 – 107.0 mg/l SiO_2	Molybdatosilicate
171	Silicate (Silicic acid) Test*	100857	11 – 1070 mg/l SiO_2	Molybdatosilicate
225	Silicate (Silicic acid) Test	101813	0.0005 – 0.5000 mg/l SiO_2	Silicomolybdenum blue
047	Silver Test*	114831	0.25 – 3.00 mg/l Ag	Eosine / 1,10-phenanthroline
168	Sodium Cell Test in nutrient solutions*	100885	10 – 300 mg/l Na	indirectly as chloride
300	Spectral Absorption Coefficient α(254)	α254	0.5 – 250 m^{-1}	Measurement at 254 nm
301	Spectral Attenuation Coefficient μ(254)*	μ254	0.5 – 250 m^{-1}	Measurement at 254 nm
302	Spectral Absorption Coefficient α(436)	α436	0.5 – 250 m^{-1}	Measurement at 436 nm
229	Sulfate Cell Test	102532	1,0 – 50,0 mg/l SO_4	Bariumsulfate, turbidimetric
064	Sulfate Cell Test	114548	5 – 250 mg/l SO_4	Bariumsulfate, turbidimetric
154	Sulfate Cell Test	100617	50 – 500 mg/l SO_4	Bariumsulfate, turbidimetric
082	Sulfate Cell Test	114564	100 – 1000 mg/l SO_4	Bariumsulfate, turbidimetric
065	Sulfate Test*	114791	25 – 300 mg/l SO_4	Tannin
224	Sulfate Test	101812	0.50 – 50.0 mg/l SO_4	Bariumsulfate, turbidimetric
230	Sulfate Test	102537	5 – 300 mg/l SO_4	Bariumsulfate, turbidimetric
080	Sulfide Test*	114779	0.020 – 1.50 mg/l S	Dimethyl-p-phenylendiamine
127	Sulfite Cell Test*	114394	1.0 – 20.0 mg/l SO_3	Ellman's reagent
127	Sulfite Cell Test sensitive*	114394	0.05 – 3.00 mg/l SO_3	Ellman's reagent
187	Sulfite Test*	101746	1.0 – 60.0 mg/l SO_3	Ellman's reagent
087	Surfactants (anionic) Cell Test	114697 (methylene blue active substances)	0.05 – 2.00 mg/l MBAS	Methylene blue
231	Surfactants (anionic) Cell Test	102552 (methylene blue active substances)	0.05 – 2.00 mg/l MBAS	Methylene blue
192	Surfactants (cationic) Cell Test*	101764	0.05 – 1.50 mg/l k-Ten	Disulfine blue
193	Surfactants (nonionic) Cell Test*	101787	0.10 – 7.50 mg/l n-Ten	TBPE
182	Suspended Solids	Susp.solid	25 – 750 mg/l SusS	
100	Tin Cell Test*	114622	0.10 – 2.50 mg/l Sn	Pyrocatechol violet
172	TOC Cell Test	114878	5.0 – 80.0 mg/l TOC	Peroxodisulfate oxidation, indicator
173	TOC Cell Test	114879	50 – 800 mg/l TOC	Peroxodisulfate oxidation, indicator
178	Total Hardness Cell Test*	100961	5 – 215 mg/l Ca	Phthalein purple
	Water hardness see Total Hardness or Residual Hardness			
077	Turbidity	T550	1 – 100 FAU	Measurement at 550 nm
191	Volatile Organic Acids Cell Test*	101763	50 – 3000 mg/l HOAc	Esterification
222	Volatile Organic Acids Cell Test*	101749	50 – 3000 mg/l CH_3COOH	Esterification
223	Volatile Organic Acids Test*	101809	50 – 3000 mg/l CH_3COOH	Esterification
174	Zinc Cell Test	100861	0.025 – 1.000 mg/l Zn	PAR
074	Zinc Cell Test	114566	0.20 – 5.00 mg/l Zn	PAR
041	Zinc Test*	114832	0.05 – 2.50 mg/l Zn	Cl-PAN

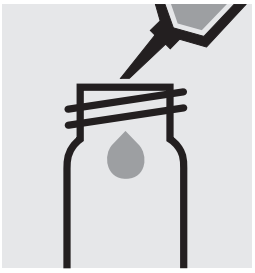
* turbidity correction possible
** individual calibration necessary

Acid Capacity to pH 4.3 (Total Alkalinity)

101758

Cell Test

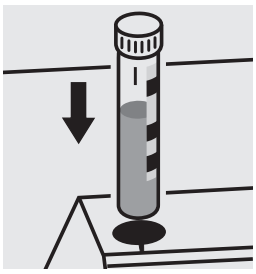
Measuring range:	0.40 –	8.00	mmol/l
	20 –	400	mg/l $CaCO_3$



Pipette 4.0 ml of **AC-1** into a round cell.

Add 1.0 ml of the sample with pipette, close the cell with the screw cap, and mix.

Add 0.50 ml of **AC-2** with pipette, close the cell with the screw cap, and mix.



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) a sodium hydroxide solution 0.1 mol/l, Cat.No. 109141, can be used after diluting accordingly (see section “Standard solutions”).

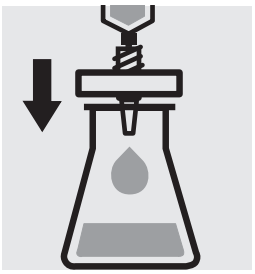
ADMI Color Measurement

Application

corresponds to **APHA 2120F** (ADMI Weighted-Ordinate Spectrophotometric Method)

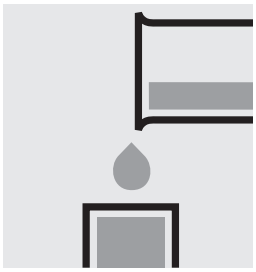
Measuring	10	– 500	10-mm cell	Method No. 2517
range:	2.0	– 100.0	50-mm cell	Method No. 2518
Attention!	The measurement is carried out in a corresponding rectangular cell against a blank, prepared from distilled water (Water for analysis EMSURE®, Cat.No. 116754, is recommended).			

Preparation:

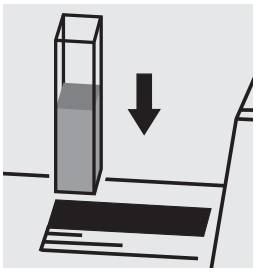


Filter turbid samples.

Determination at the original pH:

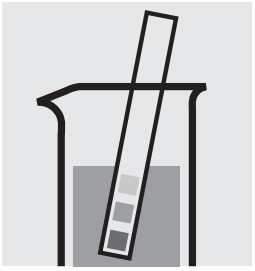


Transfer the solution into a corresponding cell.

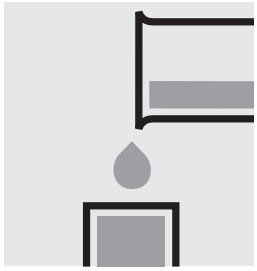


Place the cell into the cell compartment.
Select method no. **2517** or **2518**.

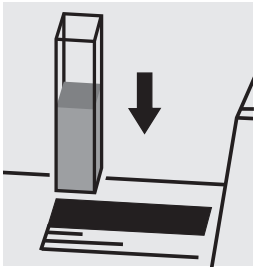
Determination at pH 7.0:



Check the pH of the sample, specified value: pH 7.0.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.



Transfer the solution into a corresponding cell.



Place the cell into the cell compartment.
Select method no. **2517** or **2518**.

Note:

This method can be recalibrated by the user (one-point calibration). This method is activated by hitting the **Blank Zero** key and is subsequently menu-controlled (see the application for further details).

In the case of **serial measurements** the accuracy of the measurement can be enhanced by making a zero setting prior to **each** individual measurement.

Important:

The exact procedure as well as further details on the method used can be found in the corresponding application. This application can be downloaded directly at www.analytical-test-kits.com.

Quality assurance:

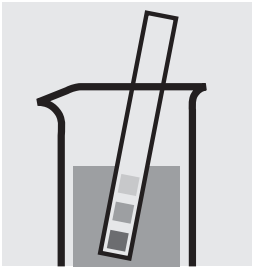
To check the measurement system (measurement device, and handling) ready-for-use platinum-cobalt color reference solution (Hazen 500) Certipur®, Cat.No. 100246, concentration 500 mg/l Pt can be used after diluting accordingly.

Aluminium

100594

Cell Test

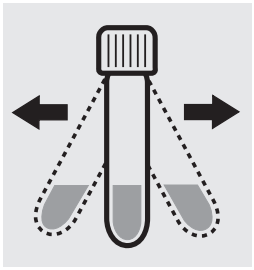
Measuring range:	0.02 – 0.50 mg/l Al Expression of results also possible in mmol/l.



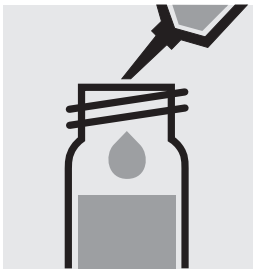
Check the pH of the sample, specified range: pH 3 – 10.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.

Pipette 6.0 ml of the sample into a reaction cell, close with the screw cap, and mix.

Add 1 level blue microspoon of **Al-1K**, close with the screw cap.

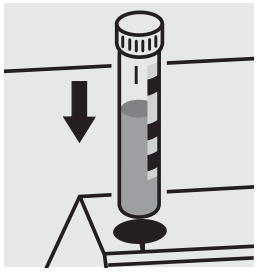


Shake the cell vigorously to dissolve the solid substance.



Add 0.25 ml of **Al-2K** with pipette, close with the screw cap, and mix.

Reaction time:
5 minutes



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

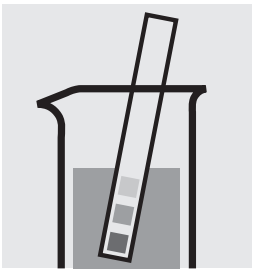
To check the measurement system (test reagents, measurement device, and handling) ready-for-use aluminium standard solution Certipur®, Cat.No. 119770, concentration 1000 mg/l Al can be used after diluting accordingly.

Aluminium

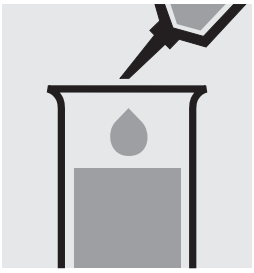
114825

Test

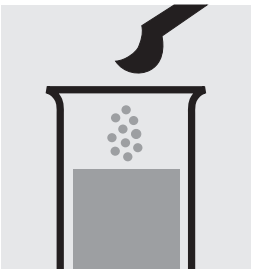
Measuring	0.10 – 1.20 mg/l Al	10-mm cell
range:	0.05 – 0.60 mg/l Al	20-mm cell
	0.020 – 0.200 mg/l Al	50-mm cell
	Expression of results also possible in mmol/l.	



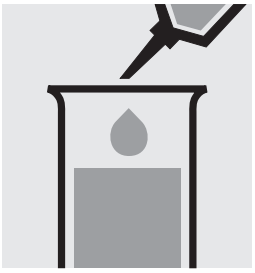
Check the pH of the sample, specified range: pH 3 – 10.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.



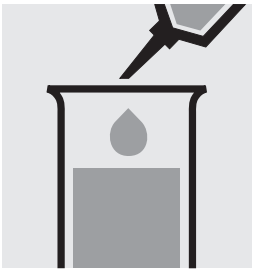
Pipette 5.0 ml of the sample into a test tube.



Add 1 level blue microspoon of **Al-1** to the test tube and dissolve the solid substance.

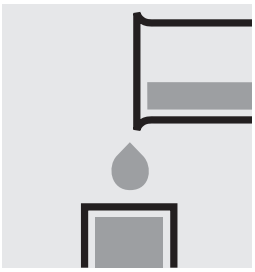


Add 1.2 ml of **Al-2** with pipette and mix.

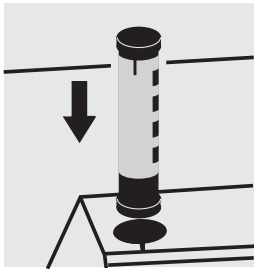


Add 0.25 ml of **Al-3** with pipette and mix.

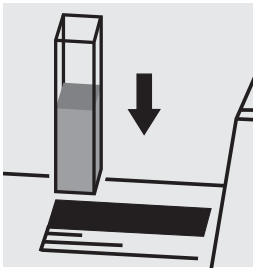
Reaction time:
2 minutes



Transfer the solution into a corresponding cell.



Select method with AutoSelector.



Place the cell into the cell compartment.

Important:

To measure in the 50-mm cell, the sample volume and the volume of the reagents have to be doubled for each. Alternatively, the semi-microcell, Cat.No. 173502, can be used.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) we recommended to use Spectroquant® CombiCheck 40, Cat.No. 114692.

Ready-for-use aluminium standard solution Certipur®, Cat.No. 119770, concentration 1000 mg/l Al, can also be used after diluting accordingly.

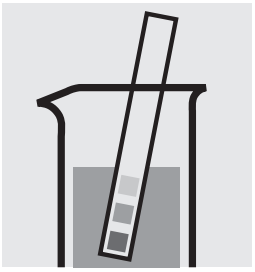
To check for sample-dependent effects the use of addition solutions (e.g. in CombiCheck 40) is highly recommended.

Ammonia, free

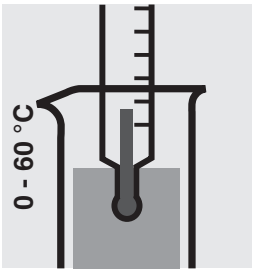
(as ammonium)

Application

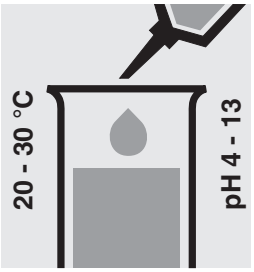
Measuring	0.00 – 3.65 mg/l NH_3	0.00 – 3.00 mg/l NH_3-N	10-mm cell	Method No. 2520
range:	0.00 – 1.83 mg/l NH_3	0.00 – 1.50 mg/l NH_3-N	20-mm cell	Method No. 2521
	0.000 – 0.730 mg/l NH_3	0.000 – 0.600 mg/l NH_3-N	50-mm cell	Method No. 2522



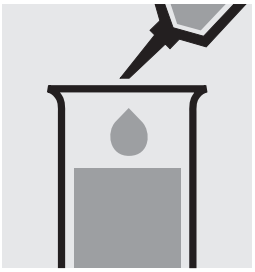
Check the pH of the sample **and note**.



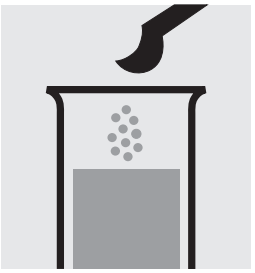
Check the temperature of the solution **and note**.



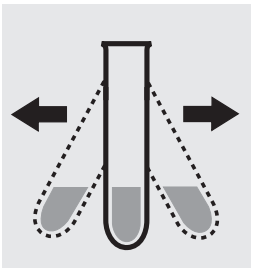
Pipette 5.0 ml of the sample into a test tube. If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH and bring the sample to the appropriate temperature.



Add 0.60 ml of **NH_4-1** (from Spectroquant® Ammonium Test, Cat. No. 114752) with pipette and mix.

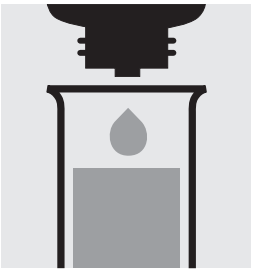


Add 1 level blue microspoon of **NH_4-2** (from Spectroquant® Ammonium Test, Cat. No. 114752).



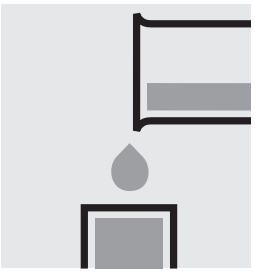
Shake vigorously to dissolve the solid substance.

Reaction time:
5 minutes



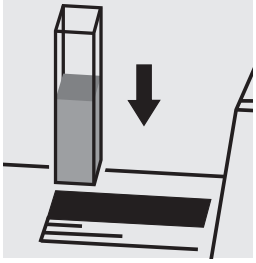
Add 4 drops of **NH_4-3** (from Spectroquant® Ammonium Test, Cat. No. 114752) and mix.

Reaction time:
5 minutes

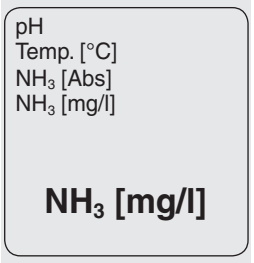


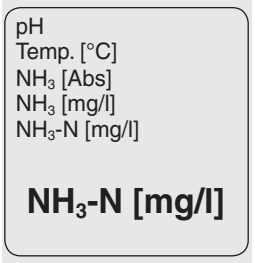
Transfer the solution into a corresponding cell.

Select method no. **2520**, **2521**, or **2518**.
Enter the pH and the temperature of the original sample.



Place the cell into the cell compartment.





Important:

Very high ammonium concentrations in the sample produce turquoise-colored solutions (measurement solution should be yellow-green to green) and false-low readings are yielded. In such cases the sample must be diluted (plausibility check).

To measure in the 50-mm cell, the sample volume and the volume of the reagents have to be doubled for each. Alternatively, the semi-microcell, Cat.No. 173502, can be used.

Important:

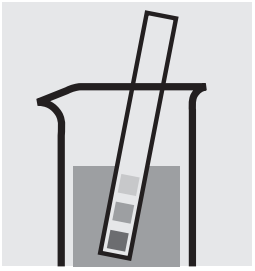
The exact procedure as well as further details on the method used can be found in the corresponding application. This application can be downloaded directly at www.analytical-test-kits.com.

Ammonium

114739

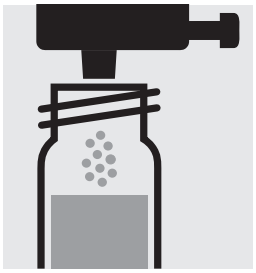
Cell Test

Measuring	0.010 – 2.000 mg/l NH_4-N
range:	0.01 – 2.58 mg/l NH_4
	0.010 – 2.000 mg/l NH_3-N
	0.01 – 2.43 mg/l NH_3
	Expression of results also possible in mmol/l.

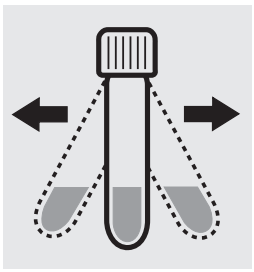


Check the pH of the sample, specified range: pH 4 – 13.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.

Pipette 5.0 ml of the sample into a reaction cell close with the screw cap, and mix.

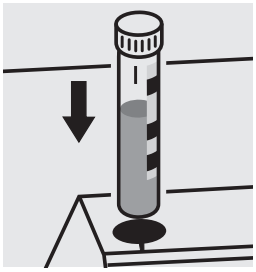


Add 1 dose of **NH_4-1K** using the blue dose-metering cap, close the cell with the screw cap.



Shake the cell vigorously to dissolve the solid substance.

Reaction time: 15 minutes



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Important:

Very high ammonium concentrations in the sample produce turquoise-colored solutions (measurement solution should be yellow-green to green) and false-low readings are yielded. In such cases the sample must be diluted (plausibility check).

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) we recommended to use Spectroquant® CombiCheck 50, Cat.No. 114695, or the Standard solution for photometric applications, CRM, Cat.No. 125022 and 125023.

Ready-for-use ammonium standard solution Certipur®, Cat.No. 119812, concentration 1000 mg/l NH_4^+, can also be used after diluting accordingly.

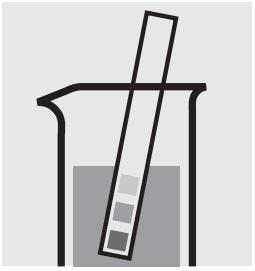
To check for sample-dependent effects the use of addition solutions (e.g. in CombiCheck 50) is highly recommended.

Ammonium

114558

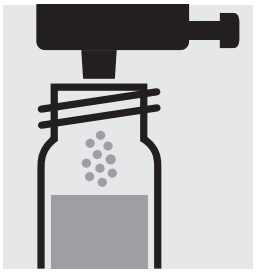
Cell Test

Measuring range:	0.20 – 8.00 mg/l NH_4-N
	0.26 – 10.30 mg/l NH_4
	0.20 – 8.00 mg/l NH_3-N
	0.24 – 9.73 mg/l NH_3
	Expression of results also possible in mmol/l.

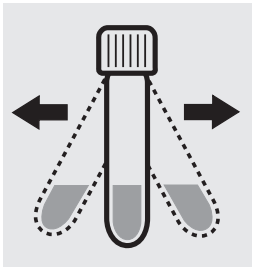


Check the pH of the sample, specified range: pH 4 – 13
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.

Pipette 1.0 ml of the sample into a reaction cell close with the screw cap, and mix.

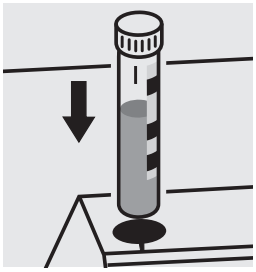


Add 1 dose of **NH_4-1K** using the blue dose-metering cap, close the cell with the screw cap.



Shake the cell vigorously to dissolve the solid substance.

Reaction time: 15 minutes



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Important:

Very high ammonium concentrations in the sample produce turquoise-colored solutions (measurement solution should be yellow-green to green) and false-low readings are yielded. In such cases the sample must be diluted (plausibility check).

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) we recommended to use Spectroquant® CombiCheck 10, Cat.No. 114676, or the Standard solution for photometric applications, CRM, Cat.No. 125022, 125023, 125024, and 125025.

Ready-for-use ammonium standard solution Certipur®, Cat.No. 119812, concentration 1000 mg/l NH_4^+, can also be used after diluting accordingly.

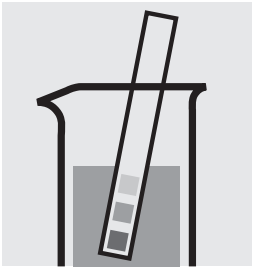
To check for sample-dependent effects the use of addition solutions (e.g. in CombiCheck 10) is highly recommended.

Ammonium

114544

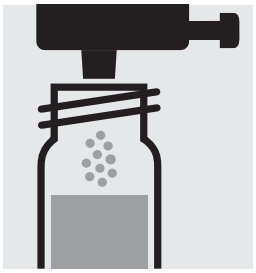
Cell Test

Measuring range:	0.5 – 16.0 mg/l NH_4-N
	0.6 – 20.6 mg/l NH_4
	0.5 – 16.0 mg/l NH_3-N
	0.6 – 19.5 mg/l NH_3
	Expression of results also possible in mmol/l.

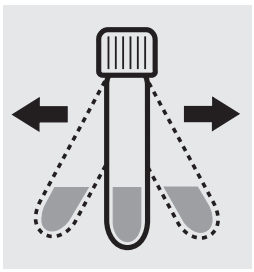


Check the pH of the sample, specified range: pH 4 – 13.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.

Pipette 0.50 ml of the sample into a reaction cell close with the screw cap, and mix.

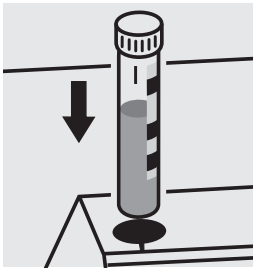


Add 1 dose of **NH_4-1K** using the blue dose-metering cap, close the cell with the screw cap.



Shake the cell vigorously to dissolve the solid substance.

Reaction time: 15 minutes



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Important:

Very high ammonium concentrations in the sample produce turquoise-colored solutions (measurement solution should be yellow-green to green) and false-low readings are yielded. In such cases the sample must be diluted (plausibility check).

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) we recommended to use Spectroquant® CombiCheck 20, Cat.No. 114675, or the Standard solution for photometric applications, CRM, Cat.No. 125023, 125024, 125025, and 125026.

Ready-for-use ammonium standard solution Certipur®, Cat.No. 119812, concentration 1000 mg/l NH_4^+, can also be used after diluting accordingly.

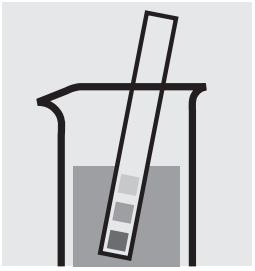
To check for sample-dependent effects the use of addition solutions (e.g. in CombiCheck 20) is highly recommended.

Ammonium

114559

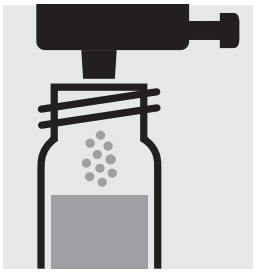
Cell Test

Measuring range:	4.0 – 80.0 mg/l NH_4-N
	5.2 – 103.0 mg/l NH_4
	4.0 – 80.0 mg/l NH_3-N
	4.9 – 97.3 mg/l NH_3
	Expression of results also possible in mmol/l.

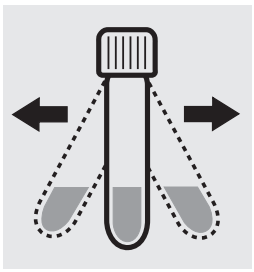


Check the pH of the sample, specified range: pH 4 – 13.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.

Pipette 0.10 ml of the sample into a reaction cell close with the screw cap, and mix.

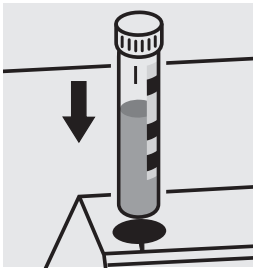


Add 1 dose of **NH_4-1K** using the blue dose-metering cap, close the cell with the screw cap.



Shake the cell vigorously to dissolve the solid substance.

Reaction time: 15 minutes



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Important:

Very high ammonium concentrations in the sample produce turquoise-colored solutions (measurement solution should be yellow-green to green) and false-low readings are yielded. In such cases the sample must be diluted (plausibility check).

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) we recommended to use Spectroquant® CombiCheck 70, Cat.No. 114689, or the Standard solution for photometric applications, CRM, Cat.No. 125025, 125026, and 125027.

Ready-for-use ammonium standard solution Certipur®, Cat.No. 119812, concentration 1000 mg/l NH_4^+, can also be used after diluting accordingly.

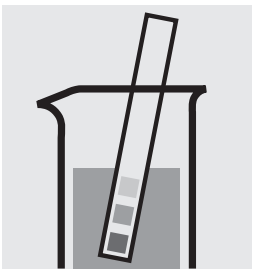
To check for sample-dependent effects the use of addition solutions (e.g. in CombiCheck 70) is highly recommended.

Ammonium

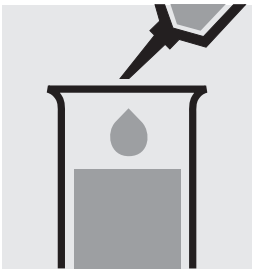
114752

Test

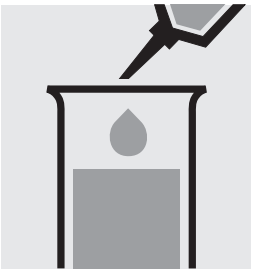
Measuring	0.05 – 3.00	mg/l NH_4-N	0.06 – 3.86 mg/l NH_4	10-mm cell
range:	0.05 – 3.00	mg/l NH_3-N	0.06 – 3.65 mg/l NH_3	10-mm cell
	0.03 – 1.50	mg/l NH_4-N	0.04 – 1.93 mg/l NH_4	20-mm cell
	0.03 – 1.50	mg/l NH_3-N	0.04 – 1.82 mg/l NH_3	20-mm cell
	0.010 – 0.500	mg/l NH_4-N	0.013 – 0.644 mg/l NH_4	50-mm cell
	0.010 – 0.500	mg/l NH_3-N	0.013 – 0.608 mg/l NH_3	50-mm cell
	Expression of results also possible in mmol/l.			



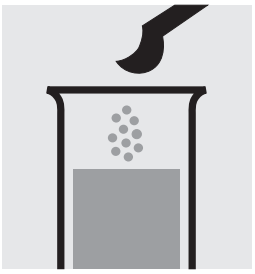
Check the pH of the sample, specified range: pH 4 – 13.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.



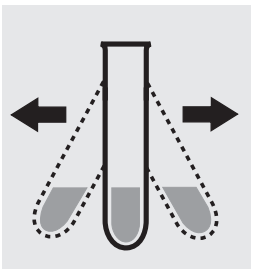
Pipette 5.0 ml of the sample into a test tube.



Add 0.60 ml of **NH_4-1** with pipette and mix.

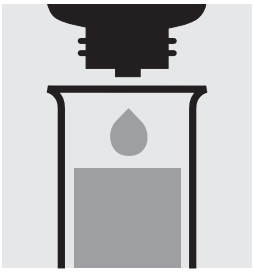


Add 1 level blue microspoon of **NH_4-2**.



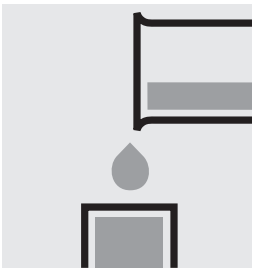
Shake vigorously to dissolve the solid substance.

Reaction time:
5 minutes

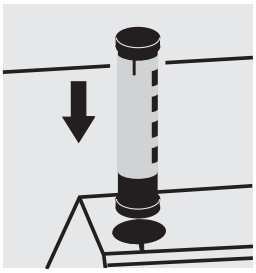


Add 4 drops of **NH_4-3** and mix.

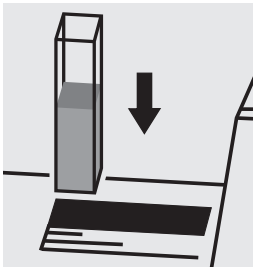
Reaction time:
5 minutes



Transfer the solution into a corresponding cell.



Select method with AutoSelector.



Place the cell into the cell compartment.

Important:

Very high ammonium concentrations in the sample produce turquoise-colored solutions (measurement solution should be yellow-green to green) and false-low readings are yielded. In such cases the sample must be diluted (plausibility check).

To measure in the 50-mm cell, the sample volume and the volume of the reagents have to be doubled for each. Alternatively, the semi-microcell, Cat.No. 173502, can be used.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) we recommended to use Spectroquant® CombiCheck 50, Cat.No. 114695, or the Standard solution for photometric applications, CRM, Cat.No. 125022, 125023, and 125024.

Ready-for-use ammonium standard solution Certipur®, Cat.No. 119812, concentration 1000 mg/l NH_4^+, can also be used after diluting accordingly.

To check for sample-dependent effects the use of addition solutions (e.g. in CombiCheck 50) is highly recommended.

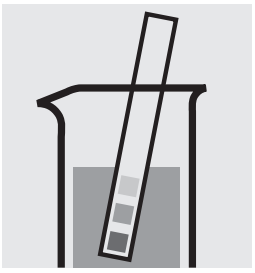
Ammonium

100683

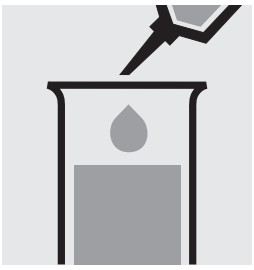
Test

Measuring range:	2.0 – 75.0 mg/l NH_4-N	2.6 – 96.6 mg/l NH_4	10-mm cell
	5 – 150 mg/l NH_4-N	6 – 193 mg/l NH_4	10-mm cell
	2.0 – 75.0 mg/l NH_3-N	2.4 – 91.2 mg/l NH_3	10-mm cell
	5 – 150 mg/l NH_3-N	6 – 182 mg/l NH_3	10-mm cell
	Expression of results also possible in mmol/l.		

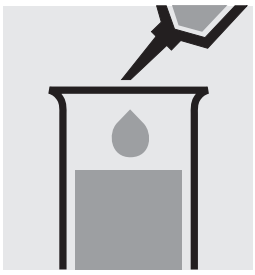
Measuring range: 2.0 – 75.0 mg/l NH_4-N



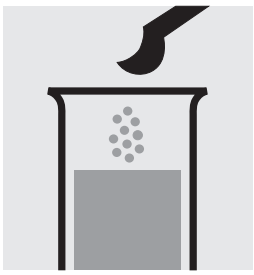
Check the pH of the sample, specified range: pH 4 – 13.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.



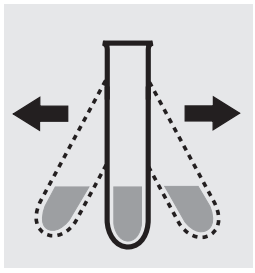
Pipette 5.0 ml of **NH_4-1** into a test tube.



Add 0.20 ml of the sample with pipette.

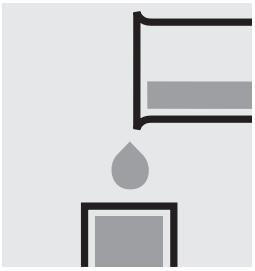


Add 1 level blue micro-spoon of **NH_4-2**.

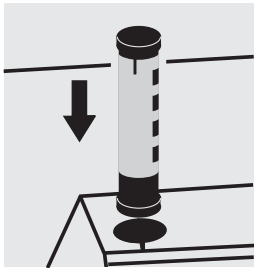


Shake vigorously to dissolve the solid substance.

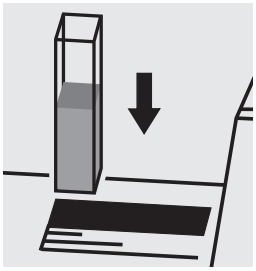
Reaction time:
15 minutes



Transfer the solution into a cell.

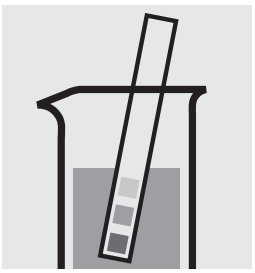


Select method with AutoSelector measuring range 2.0 – 75.0 mg/l NH_4-N.

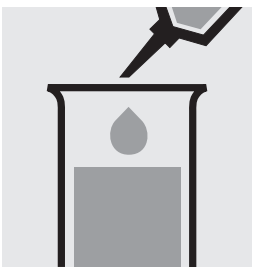


Place the cell into the cell compartment.

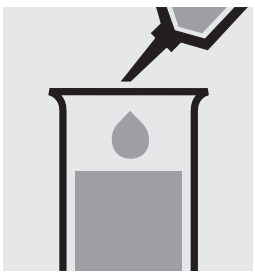
Measuring range: 5 – 150 mg/l NH_4-N



Check the pH of the sample, specified range: pH 4 – 13.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.



Pipette 5.0 ml of **NH_4-1** into a test tube.



Add 0.10 ml of the sample with pipette.

Continue as mentioned above; starting from the addition of **NH_4-2** (Fig. 4). Select method with AutoSelector measuring range 5 – 150 mg/l NH_4-N.

Important:

Very high ammonium concentrations in the sample produce turquoise-colored solutions (measurement solution should be yellow-green to green) and false-low readings are yielded. In such cases the sample must be diluted (plausibility check).

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) we recommended to use Spectroquant® CombiCheck 70, Cat.No. 114689, or the Standard solution for photometric applications, CRM, Cat.No. 125025, 125026, and 125027.

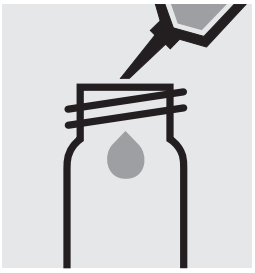
Ready-for-use ammonium standard solution Certipur®, Cat.No. 119812, concentration 1000 mg/l NH_4^+, can also be used after diluting accordingly.

To check for sample-dependent effects the use of addition solutions (e.g. in CombiCheck 70) is highly recommended.

Antimony in water and wastewater

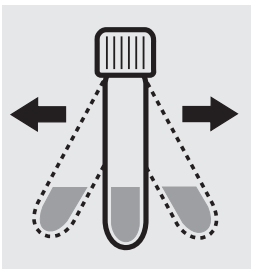
Application

Measuring range: 0.10 – 8.00 mg/l Sb 10-mm cell



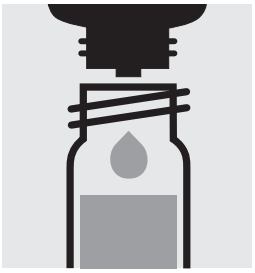
Pipette 4.0 ml of the sample into an empty round cell (Empty cells, Cat.No. 114724).

Add approx. 1.5 g of **aluminium chloride hexahydrate extra pure** (Cat.No. 101084), close the cell with the screw cap.



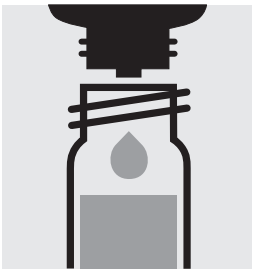
Shake the cell vigorously to dissolve the solid substance.

Add 1.0 ml **phosphoric acid 85 % GR** (Cat.No. 100573) with pipette, close the cell with the screw cap, and mix.



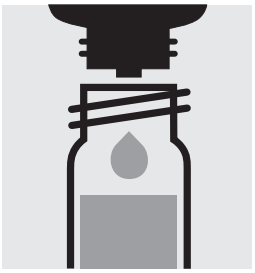
Add 2 drops of **reagent 1**, close the cell with the screw cap, and mix.

Reaction time:
3 minutes



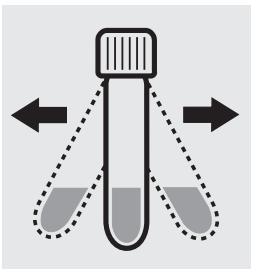
Add 2 drops of **reagent 2**, close the cell with the screw cap, and mix.

Reaction time:
2 minutes

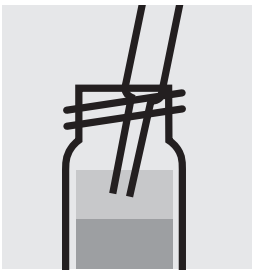


Add 2 drops of **reagent 3**, close the cell with the screw cap, and mix.

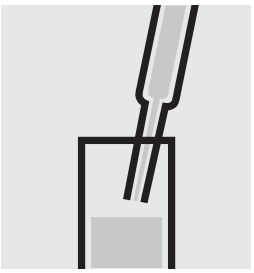
Add 5.0 ml **toluene GR** (Cat.No. 108325) with pipette, close the cell with the screw cap.



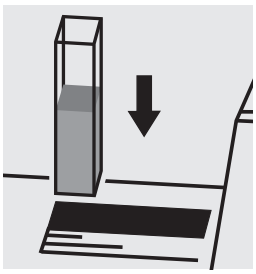
Shake the cell vigorously for 30 seconds. Leave to stand to allow phases to separate.



Aspirate the clear upper phase from the tube with pipette.



Transfer the solution into a rectangular cell.



Place the cell into the cell compartment. Select method no. **130**.

Note:

Empty cells with screw caps, Cat.No. 114724 are recommended for the preparation. These cells can be sealed with the screw caps, thus enabling a hazard-free mixing of the sample.

Important:

The exact composition and preparation of the reagents 1, 2, and 3 used are given in the corresponding application, which also includes further information on the method employed. This application can be downloaded directly at www.analytical-test-kits.com.

AOX

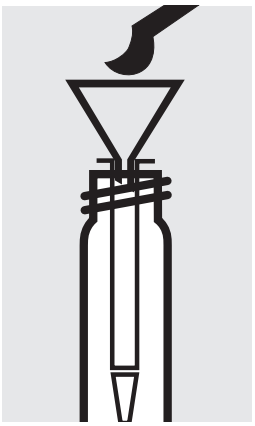
Adsorbable Organic Halogens (x)

100675

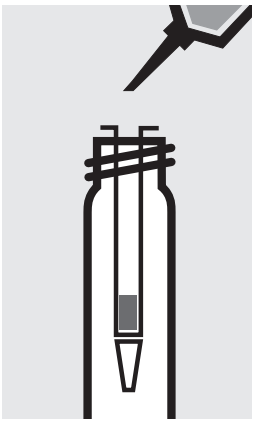
Cell Test

Measuring range: 0.05 – 2.50 mg/l AOX

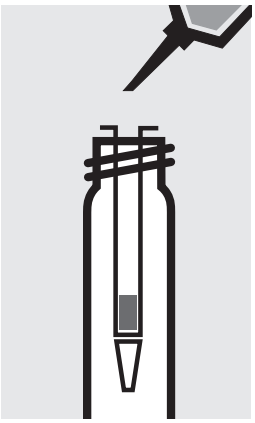
Preparation of the adsorption column:



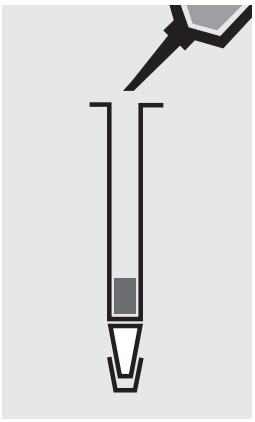
Place the column in an empty cell. Fill 1 level blue microspoon of **AOX-1** into the column using the glass funnel.



Run 3 separate 1-ml portions of **AOX-2** through the column. Discard the wash solution.

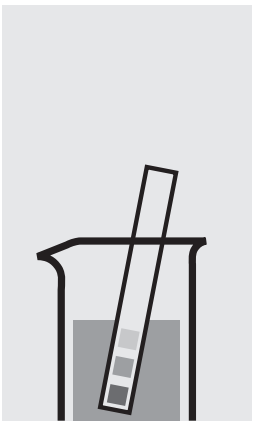


Run 3 separate 1-ml portions of **AOX-3** through the column. Discard the wash solution.

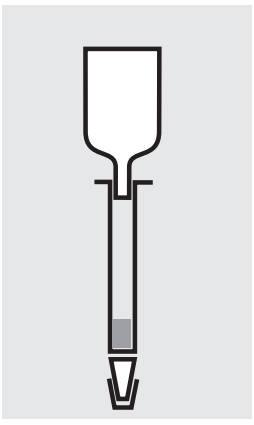


Close the bottom end of the column with the stopper. Apply to the column 1 ml of **AOX-3**. Close the top end of the column with the stopper and swirl to eliminate air bubbles. Remove the stopper on the top end and fill the column to the brim with **AOX-3**.

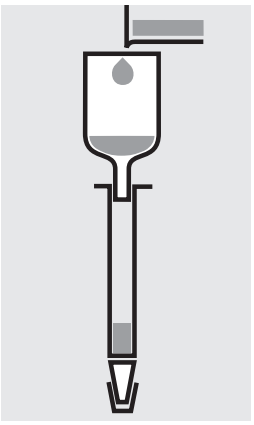
Sample enrichment:



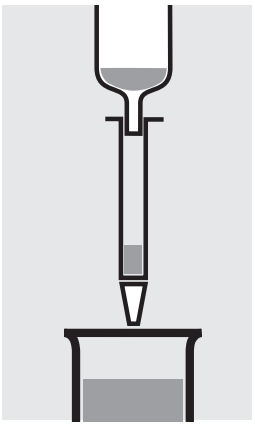
Check the pH of the sample, specified range: pH 6 – 7.
If required, add dilute sodium hydroxide solution or nitric acid drop by drop to adjust the pH.



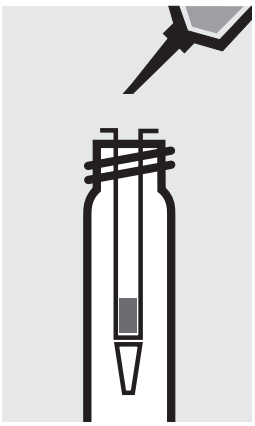
Attach the glass reservoir to the prepared column (closed at the bottom end).



Fill 100 ml of the sample and 6 drops of **AOX-4** into the reservoir.



Remove the stopper from the column outlet and run the sample through completely.



Detach the column from the reservoir. Apply 3 separate 1-ml portions of **AOX-3**. Discard the wash solution.

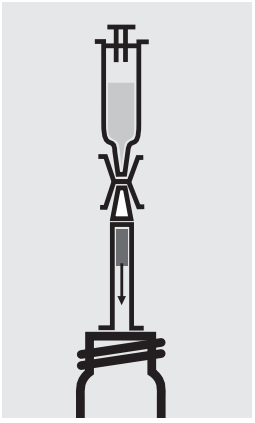
AOX

Adsorbable Organic Halogens (x)

100675

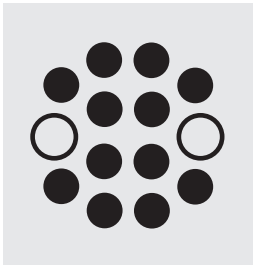
Cell Test

Digestion:

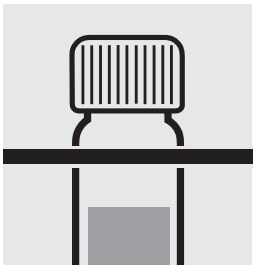


Fill the 10-ml syringe with 10 ml of reagent **AOX-5** and attach the syringe with the column outlet using the connector. Place the top end of the column on an empty cell and rinse the charcoal filling of the column into an empty 16-mm cell.

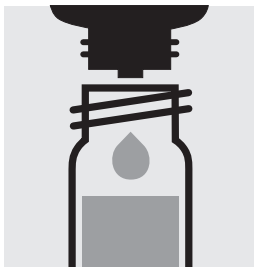
Add 2 level green micro-spoons of **AOX-6**, close the cell with the screw cap, and mix.



Heat the cell at 120 °C in the thermoreactor for 30 minutes.



Remove the cell from the thermoreactor and place in a test-tube rack to cool to room temperature.



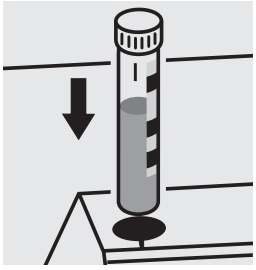
Add 5 drops of **AOX-4**, close the cell and mix; clear supernatant: **pretreated sample**.

Determination:

Pipette 0.20 ml of **AOX-1K** into a reaction cell, and mix.

Add 7.0 ml of **pretreated sample** with glass pipette, close the cell with the screw cap, and mix.

Reaction time: 15 minutes



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

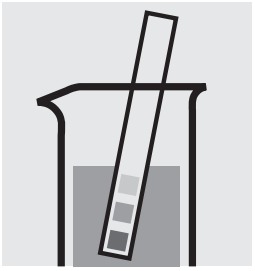
To check the measurement system (test reagents, measurement device, and handling) Spectroquant® AOX Standard, Cat.No. 100680, concentration 0.2 – 2.0 mg/l can be used.

Arsenic

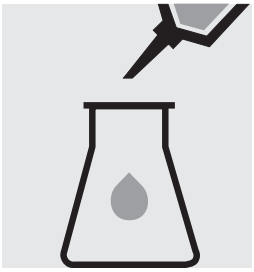
101747

Test

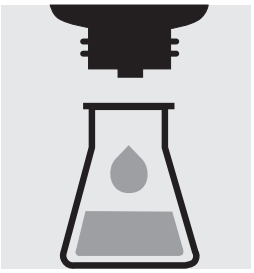
Measuring	0.005 – 0.100 mg/l As	10-mm cell
range:	0.001 – 0.020 mg/l As	20-mm cell
	Expression of results also possible in mmol/l.	



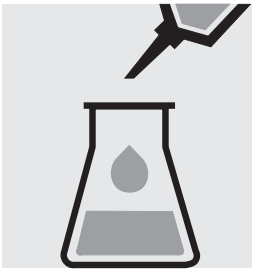
Check the pH of the sample, specified range: pH 0 – 13.



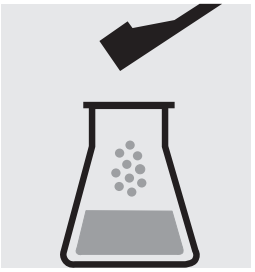
Place 350 ml of the sample into an Erlenmeyer flask with ground joint.



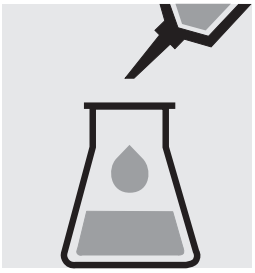
Add 5 drops of **As-1** and mix.



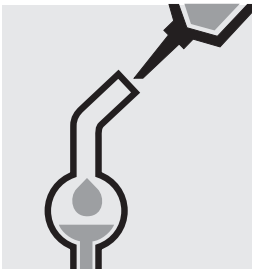
Add 20 ml of **As-2** with pipette and mix.



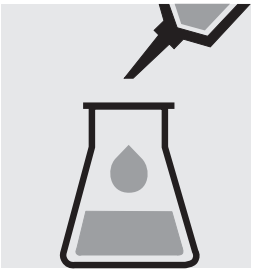
Add 1 level green dosing spoon of **As-3** and dissolve.



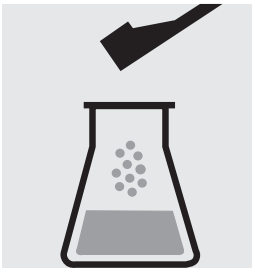
Add 1.0 ml of **As-4** with pipette and mix.



Pipette 5.0 ml of **As-5** into the absorption tube.

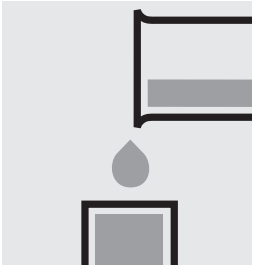


Add 1.0 ml of **As-6** with pipette to the solution in the Erlenmeyer flask and mix.

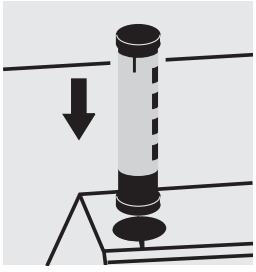


Add 3 level red dosing spoons of **As-7**. **Immediately** attach the absorption tube to the Erlenmeyer flask.

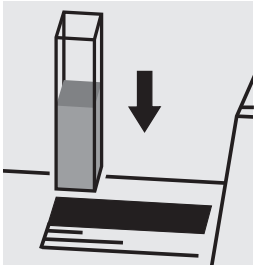
Leave to stand for 2 hours. During this time carefully swirl the flask several times or stir slowly with a magnetic stirrer.



Transfer the solution from the absorption tube into a corresponding cell.



Select method with AutoSelector.



Place the cell into the cell compartment.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) ready-for-use arsenic standard solution Certipur®, Cat.No. 119773, concentration 1000 mg/l As can be used after diluting accordingly.

BOD

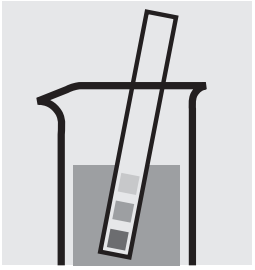
Biochemical Oxygen Demand

100687

Cell Test

Measuring range:	0.5 – 3000 mg/l BOD
	0.5 – 3000 mg/l O_2
	Expression of results also possible in mmol/l.

Preparation and incubation:



Check the pH of the sample, specified range: pH 6 – 8.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.

Fill 2 oxygen reaction bottles each with **pretreated sample** and 2 glass beads to overflowing. Close bubble-free with the slanted ground-glass stoppers.

Fill 2 oxygen reaction bottles each with **inoculated nutrient-salt solution** and 2 glass beads to overflowing. Close bubble-free with the slanted ground-glass stoppers.

Measurement of inital oxygen concentration

= Result 1
(measurement sample)
= Result 1
(blank)

Use one bottle of **pretreated sample** and one of **inoculated nutrient-salt solution** for the measurement of the initial oxygen concentration.

Incubate one bottle of **pretreated sample** and one of **inoculated nutrient-salt solution** closed in a thermostatic incubation cabinet at 20 ± 1°C for 5 days.

Determination:

Measurement of final oxygen concentration

= Result 2
(measurement sample)
= Result 2
(blank)

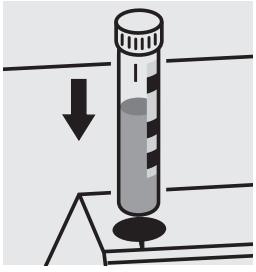
After incubation, use one bottle of **pretreated sample** and one of **inoculated nutrient-salt solution** for the measurement of the final oxygen concentration.

Add 5 drops of **BOD-1K** and then 10 drops of **BOD-2K**, close bubble-free, and mix for approx. 10 seconds.

Reaction time:
1 minute

Add 10 drops of **BOD-3K**, reclose, and mix.

Fill the solution into a round cell.



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Calculation:

BOD of measurement sample:
Result 1 – Result 2 (measurement sample) = A in mg/l

BOD of blank:
Result 1 – Result 2 (blank) = B in mg/l

BOD of original sample in mg/l = A • dilution factor – B

Quality assurance:

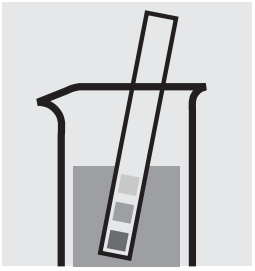
To check the measurement system (test reagents, measurement device, and handling) Spectroquant BOD Standard (acc. to EN 1899), Cat.No. 100718, can be used.

Boron

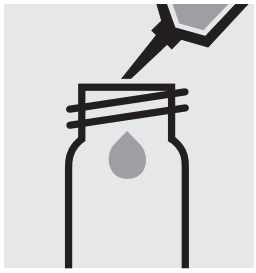
100826

Cell Test

Measuring range:	0,05 – 2,00 mg/l B Expression of results also possible in mmol/l.

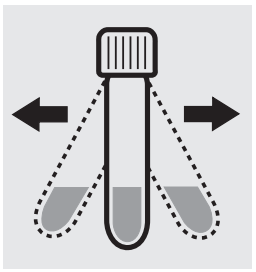


Check the pH of the sample, specified range: pH 2 – 12.
If required, add dilute sodium hydroxide solution or nitric acid drop by drop to adjust the pH.



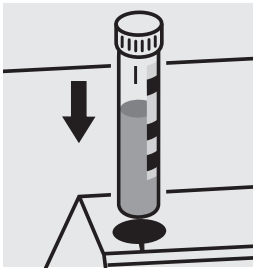
Pipette 1.0 ml of **B-1K** into a reaction cell, close with the screw cap, and mix.

Add 4.0 ml of the sample with pipette into a reaction cell, close the cell with the screw cap.



Shake the cell vigorously to dissolve the solid substance.

Reaction time: 60 minutes



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

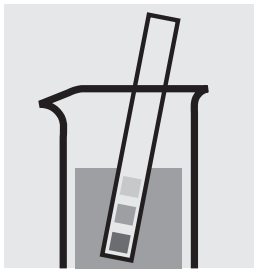
To check the measurement system (test reagents, measurement device, and handling) ready-for-use boron standard solution Certipur®, Cat.No. 119500, concentration 1000 mg/l B can also be used after diluting accordingly.

Boron

114839

Test

Measuring range:	0.050 – 0.800 mg/l B Expression of results also possible in mmol/l.	10-mm cell

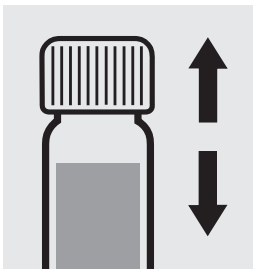


Check the pH of the sample, specified range: pH 1 – 13.

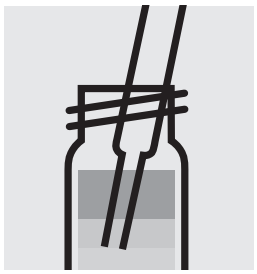
Pipette 5.0 ml of the sample into a test tube with screw cap. **(Important: Do not use test tubes made of glass containing boron!)**

Add 1.0 ml of **B-1** with pipette, close with the screw cap, and mix.

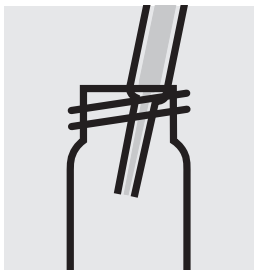
Add 1.5 ml of **B-2** with pipette and close with the screw cap.



Shake the tube vigorously for 1 minute.

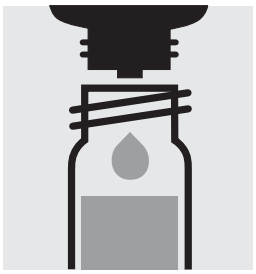


Aspirate 0.5 ml of the clear lower phase from the tube with pipette.

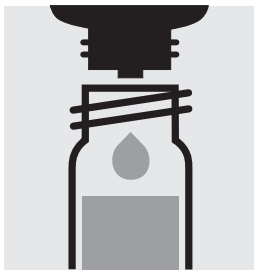


Transfer the extract to a separate fresh tube.

Add 0.80 ml of **B-3** with pipette, close with the screw cap, and mix.



Add 4 drops of **B-4**, close with the screw cap, and mix.

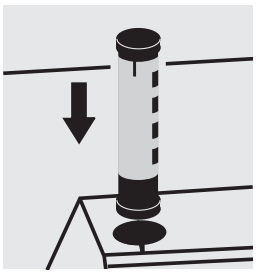


Add 15 drops of **B-5**, close with the screw cap, and mix.

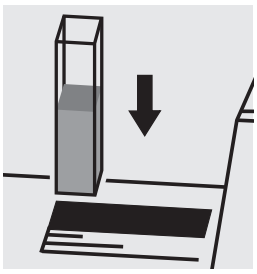
Reaction time: 12 minutes

Add 6.0 ml of **B-6** with pipette, close with the screw cap, and mix.

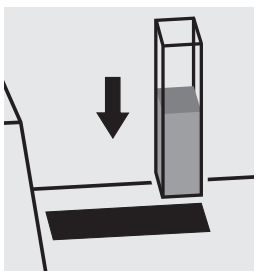
Reaction time: 2 minutes



Transfer the solution into a cell.



Select method with AutoSelector.



Place the cell into the cell compartment.

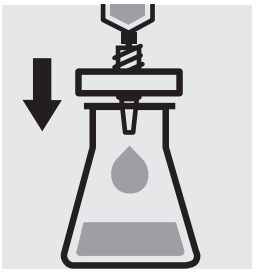
Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) ready-for-use boron standard solution Certipur®, Cat.No. 119500, concentration 1000 mg/l B can also be used after diluting accordingly.

Bromate in water and drinking water

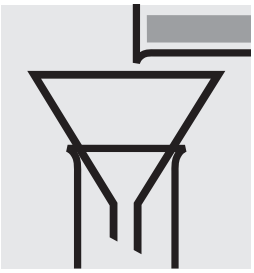
Application

Measuring range:	0.003 – 0.120 mg/l BrO_3 50-mm cell
Attention!	The measurement is carried out at 550 nm in a 50-mm rectangular cell against a blank, prepared from distilled water (Water for analysis EMSURE®, Cat.No. 116754, is recommended) and the reagents in an analogous manner.

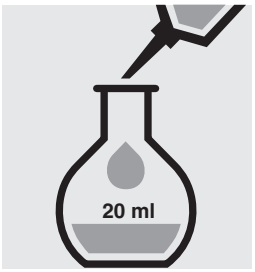


Filter turbid samples.

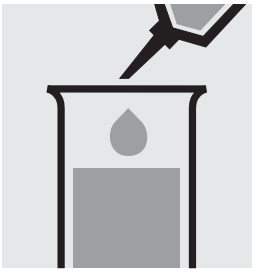
Evaporate 200 ml of sample solution in a glass beaker almost to dryness on the hob.



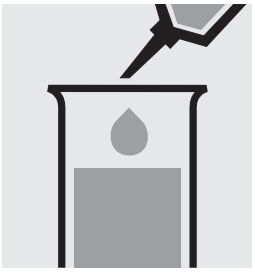
Transfer the residue to a 20-ml volumetric glass using a little distilled water (Water for analysis EMSURE®, Cat.No. 116754, is recommended).



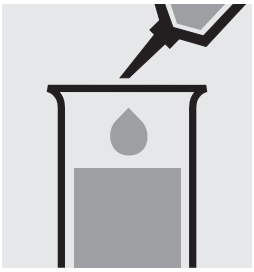
Make up the contents of the volumetric flask to the mark with distilled water (Water for analysis EMSURE®, Cat.No. 116754, is recommended) and mix thoroughly: **pretreated sample**.



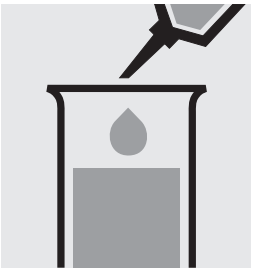
Pipette 10 ml of the pretreated sample into a test tube.



Add 0.10 ml of **reagent 1** with pipette and mix.

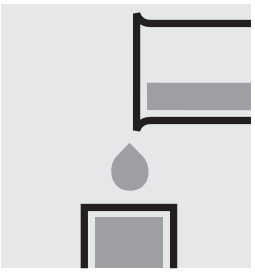


Add 0.20 ml of **reagent 2** with pipette and mix.

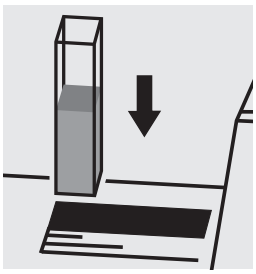


Add 0.20 ml **perchloric acid 70 - 72 % GR** (Cat.No. 100519) with pipette and mix.

Reaction time: 30 minutes



Transfer the solution into a cell.



Place the cell into the cell compartment. Select method no. **1195**.

Important:

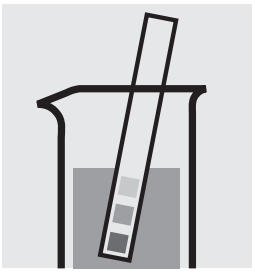
The exact composition and preparation of the reagents 1 and 2 used are given in the corresponding application, which also includes further information on the method employed. This application can be downloaded directly at www.analytical-test-kits.com.

Bromine

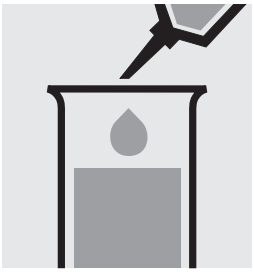
100605

Test

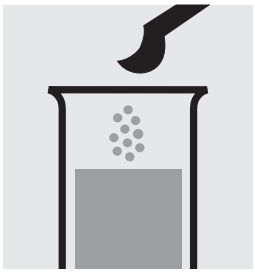
Measuring	0.10 – 10.00 mg/l Br_2	10-mm cell
range:	0.05 – 5.00 mg/l Br_2	20-mm cell
	0.020 – 2.000 mg/l Br_2	50-mm cell
	Expression of results also possible in mmol/l.	



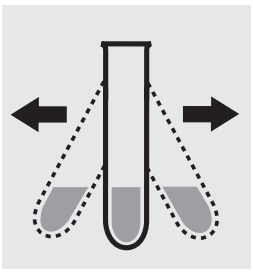
Check the pH of the sample, specified range: pH 4 – 8.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.



Pipette 10 ml of the sample into a test tube.

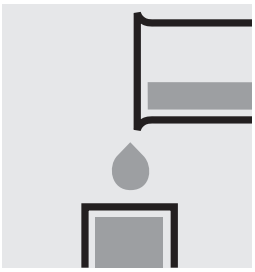


Add 1 level blue micro-spoon of **Br_2-1.**

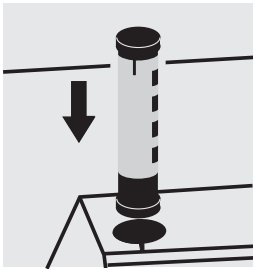


Shake vigorously to dissolve the solid substance.

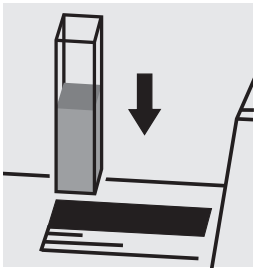
Reaction time: 1 minute



Transfer the solution into a corresponding cell.



Select method with AutoSelector.



Place the cell into the cell compartment.

Important:

Very high bromine concentrations in the sample produce yellow-colored solutions (measurement solution should be red) and false-low readings are yielded. In such cases the sample must be diluted (plausibility check).

Quality assurance:

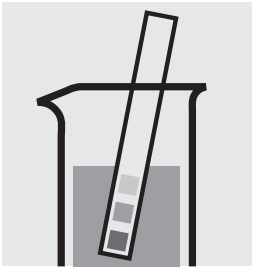
To check the measurement system (test reagents, measurement device, and handling) a freshly prepared standard solution can be used (see section “Standard solutions”).

Cadmium

114834

Cell Test

Measuring range:	0.025 – 1.000 mg/l Cd Expression of results also possible in mmol/l.

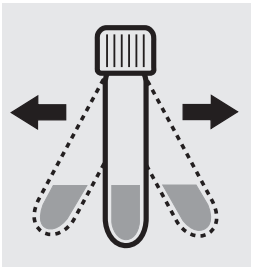


Check the pH of the sample, specified range: pH 3 – 11.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.

Pipette 5.0 ml of the sample into a reaction cell, close with the screw cap, and mix.

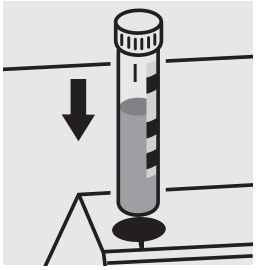
Add 0.20 ml of **Cd-1K** with pipette, close the cell with the screw cap, and mix.

Add 1 level green microspoon of **Cd-2K**, close the cell with the screw cap.



Shake the cell vigorously to dissolve the solid substance.

Reaction time:
2 minutes



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Important:

For the determination of **total cadmium** a pretreatment with Crack Set 10C, Cat.No. 114688 or Crack Set 10, Cat.No. 114687, and thermoreactor is necessary.

Result can be expressed as sum of cadmium (Σ Cd).

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) we recommended to use Spectroquant® CombiCheck 30, Cat.No. 114677.

Ready-for-use cadmium standard solution Certipur®, Cat.No. 119777, concentration 1000 mg/l Cd, can also be used after diluting accordingly.

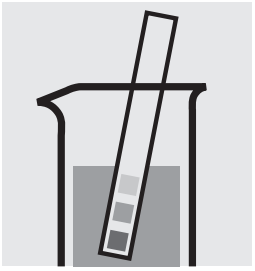
To check for sample-dependent effects the use of addition solutions (e.g. in CombiCheck 30) is highly recommended.

Cadmium

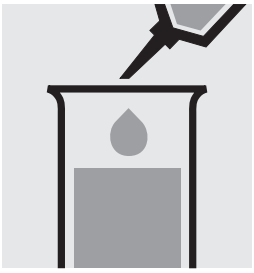
101745

Test

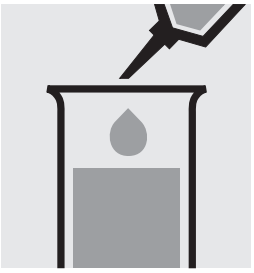
Measuring	0.01	– 0.500 mg/l Cd	10-mm cell
range:	0.005	– 0.250 mg/l Cd	20-mm cell
	0.0020	– 0.1000 mg/l Cd	50-mm cell
	Expression of results also possible in mmol/l.		



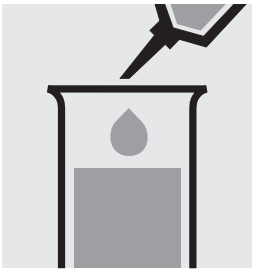
Check the pH of the sample, specified range: pH 3 – 11.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.



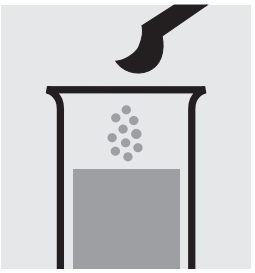
Pipette 1.0 ml of **Cd-1** into a test tube.



Add 10 ml of the sample with pipette and mix.

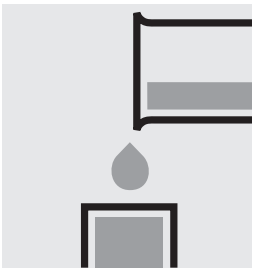


Add 0.20 ml of **Cd-2** with pipette and mix.

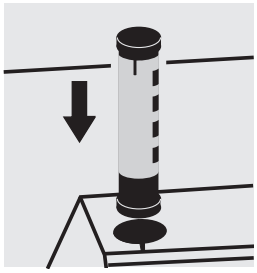


Add 1 level green microspoon of **Cd-3** and dissolve the solid substance.

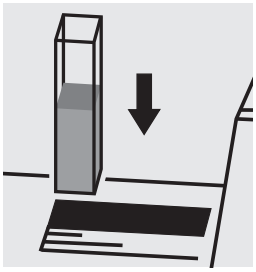
Reaction time:
2 minutes



Transfer the solution into a corresponding cell.



Select method with AutoSelector.



Place the cell into the cell compartment.

Important:

For the determination of **total cadmium** a pretreatment with Crack Set 10C, Cat.No. 114688 or Crack Set 10, Cat.No. 114687, and thermoreactor is necessary.

Result can be expressed as sum of cadmium (Σ Cd).

Quality assurance:

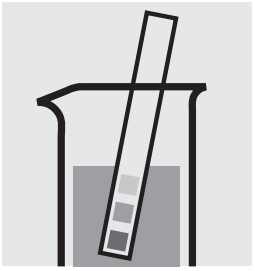
To check the measurement system (test reagents, measurement device, and handling) ready-for-use cadmium standard solution Certipur®, Cat.No. 119777, concentration 1000 mg/l Cd, can be used after diluting accordingly.

Calcium

100858

Cell Test

Measuring range:	10 – 250 mg/l Ca
	14 – 350 mg/l CaO
	25 – 624 mg/l $CaCO_3$
	Expression of results also possible in mmol/l.

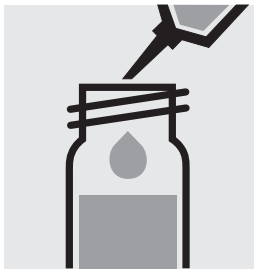


Check the pH of the sample, specified range: pH 3 – 9.
If required, add dilute sodium hydroxide solution or hydrochloric acid drop by drop to adjust the pH.

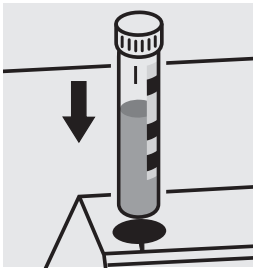
Pipette 1.0 ml of the sample into a reaction cell, close with the screw cap, and mix.

Add 1.0 ml of **Ca-1K** with pipette, close the cell with the screw cap, and mix.

Reaction time: **exactly** 3 minutes



Add 0.50 ml of **Ca-2K** with pipette, close the cell with the screw cap, and mix.



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) a freshly prepared standard solution can be used (see section “Standard solutions”).

Calcium

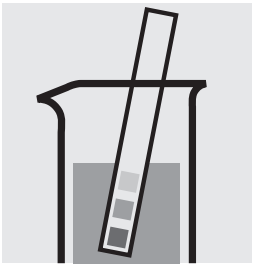
114815

Test

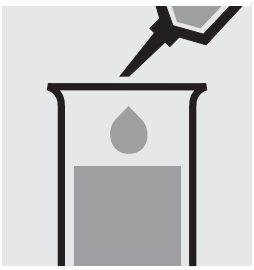
Measuring	10	– 160	mg/l Ca	14	– 224	mg/l CaO	25	– 400	mg/l $CaCO_3$	10-mm cell
range:	5	– 80	mg/l Ca	7	– 112	mg/l CaO	12	– 200	mg/l $CaCO_3$	20-mm cell
	1.0	– 15.0	mg/l Ca	1.4	– 21.0	mg/l CaO	2.5	– 37.5	mg/l $CaCO_3$	10-mm cell

Expression of results also possible in mmol/l.

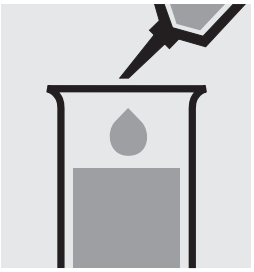
Measuring range: 5 – 160 mg/l Ca



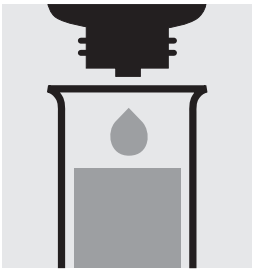
Check the pH of the sample, specified range: pH 4 – 10.
If required, add dilute sodium hydroxide solution or hydrochloric acid drop by drop to adjust the pH.



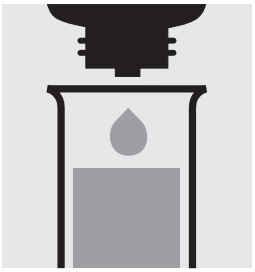
Pipette 0.10 ml of the sample into a test tube.



Add 5.0 ml of **Ca-1** with pipette and mix.

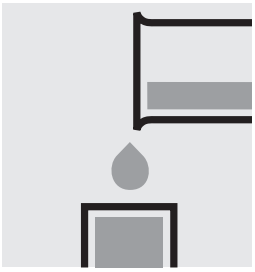


Add 4 drops of **Ca-2** and mix.

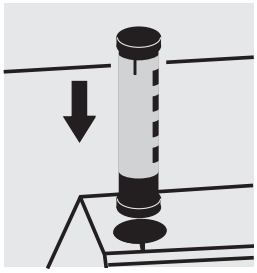


Add 4 drops of **Ca-3** and mix.

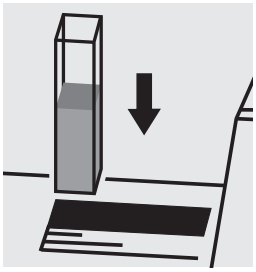
Reaction time:
8 minutes, **measure immediately**.



Transfer the solution into a corresponding cell

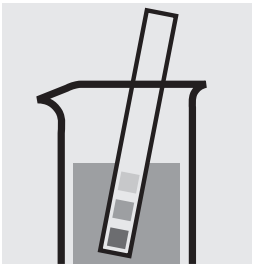


Select method with AutoSelector measuring range 5 - 160 mg/l Ca.

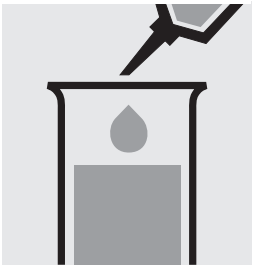


Place the cell into the cell compartment.

Measuring range: 1.0 – 15.0 mg/l Ca



Check the pH of the sample, specified range: pH 4 – 10.
If required, add dilute sodium hydroxide solution or hydrochloric acid drop by drop to adjust the pH.



Pipette 0.50 ml of the sample into a test tube.

Continue as mentioned above;
starting from the addition of **Ca-1** (Fig. 3). Measure in a 10-mm cell and select method with AutoSelector measuring range 1.0 – 15.0 mg/l Ca.

Quality assurance:

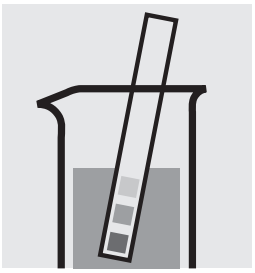
To check the measurement system (test reagents, measurement device, and handling) ready-for-use calcium standard solution Certipur®, Cat.No. 119778, concentration 1000 mg/l Ca, can be used after diluting accordingly.

Calcium

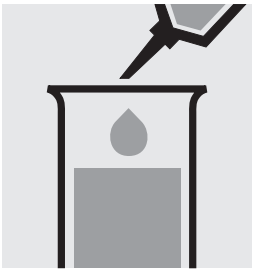
100049

Test

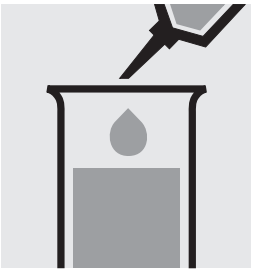
Measuring range:	0.20– 4.00 mg/l Ca Expression of results also possible in mmol/l.	10-mm cell



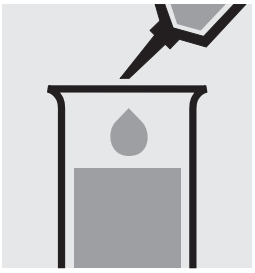
Check the pH of the sample, specified range: pH 3 – 9.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.



Pipette 5.0 ml of the sample into a test tube.

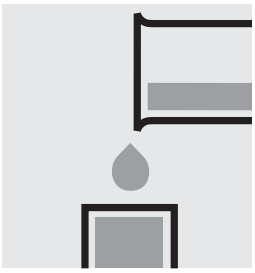


Add 0.50 ml of **Ca-1** with pipette and mix.

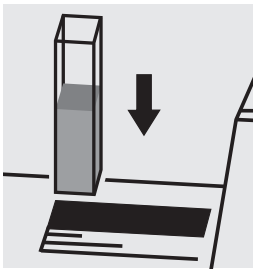


Add 0.50 ml of **Ca-2** with pipette and mix.

Reaction time: 5 minutes



Transfer the solution into a cell.



Place the cell into the cell compartment.
Select method no. **304**.

Important:

A separate calibration must be made for each batch. It is recommended to perform a calibration with a blank and 5 standard solutions over the entire measuring range. The calibration should be checked regularly using standard solutions.

Quality assurance:

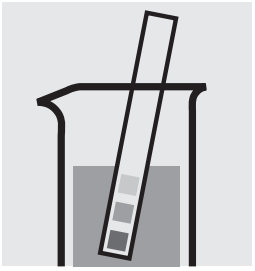
To check the measurement system (test reagents, measurement device, and handling) ready-for-use calcium standard solution Certipur®, Cat.No. 119778, concentration 1000 mg/l Ca, can be used after diluting accordingly.

Chloride

114730

Cell Test

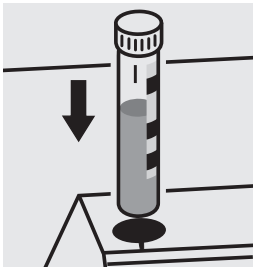
Measuring range:	5 – 125 mg/l Cl Expression of results also possible in mmol/l.



Check the pH of the sample, specified range: pH 1 – 12.
If required, add dilute ammonia solution or nitric acid drop by drop to adjust the pH.

Pipette 0.50 ml of **Cl-1K** into a reaction cell, close with the screw cap, and mix.

Add 1.0 ml of the sample with pipette, close with the screw cap, and mix.



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) we recommended to use Spectroquant® CombiCheck 10 and 20, Cat.No. 114676 and 114675.

Ready-for-use chloride standard solution Certipur®, Cat.No. 119897, concentration 1000 mg/l Cl^-, can also be used after diluting accordingly.

To check for sample-dependent effects the use of addition solutions (e.g. in CombiCheck) is highly recommended.

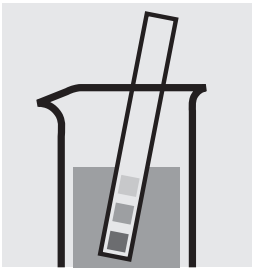
Chloride

114897

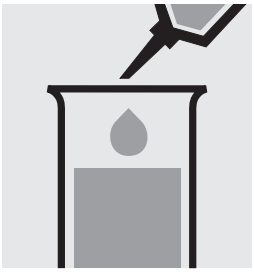
Test

Measuring	10 – 250 mg/l Cl	10-mm cell
range:	2.5 – 25.0 mg/l Cl	10-mm cell
	Expression of results also possible in mmol/l.	

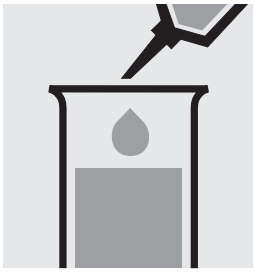
Measuring range: 10 – 250 mg/l Cl



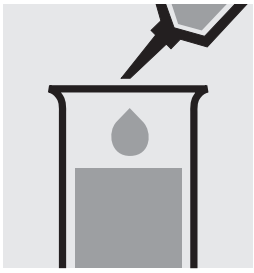
Check the pH of the sample, specified range: pH 1 – 12.
If required, add dilute ammonia solution or nitric acid drop by drop to adjust the pH.



Pipette 1.0 ml of the sample into a test tube.

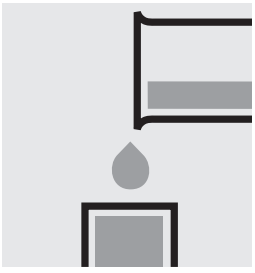


Add 2.5 ml of **Cl-1** with pipette and mix.

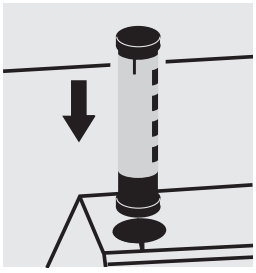


Add 0.50 ml of **Cl-2** with pipette and mix.

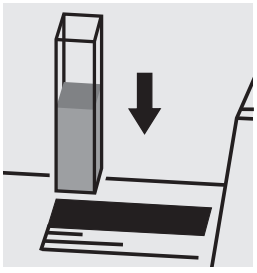
Reaction time: 1 minute



Transfer the solution into a cell.

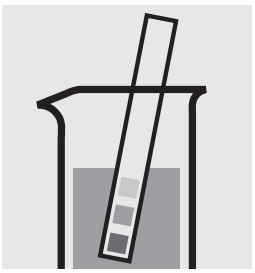


Select method with AutoSelector measuring range 10 – 250 mg/l Cl.

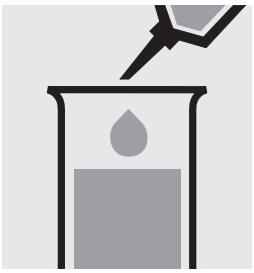


Place the cell into the cell compartment.

Measuring range: 2.5 – 25.0 mg/l Cl



Check the pH of the sample, specified range: pH 1 – 12.
If required, add dilute ammonia solution or nitric acid drop by drop to adjust the pH.



Pipette 5.0 ml of the sample into a test tube.

Continue as mentioned above; starting from the addition of **Cl-1** (Fig. 3). Select method with AutoSelector measuring range 2.5 – 25.0 mg/l Cl.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) we recommended to use Spectroquant® CombiCheck 60, Cat.No. 114696.

Ready-for-use chloride standard solution Certipur®, Cat.No. 119897, concentration 1000 mg/l Cl^-, can also be used after diluting accordingly.

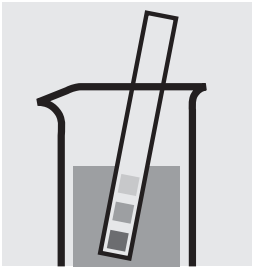
To check for sample-dependent effects the use of addition solutions (e.g. in CombiCheck 60) is highly recommended.

Chloride

101804

Cell Test

Measuring range:	0.5 – 15.0 mg/l Cl Expression of results also possible in mmol/l.

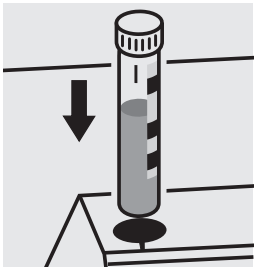


Check the pH of the sample, specified range: pH 3 – 11.
If required, add dilute ammonia solution or nitric acid drop by drop to adjust the pH.

Pipette 10 ml of the sample into a reaction cell, close with the screw cap, and mix.

Add 0.25 ml of **Cl-1K** with pipette, close with the screw cap, and mix.

Reaction time: 10 minutes



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

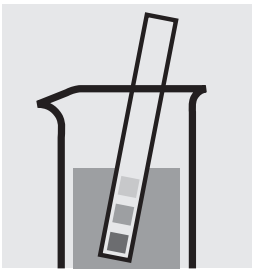
To check the measurement system (test reagents, measurement device, and handling) ready-for-use chloride standard solution Certipur®, Cat.No. 119897, concentration 1000 mg/l Cl^-, can be used after diluting accordingly.

Chloride

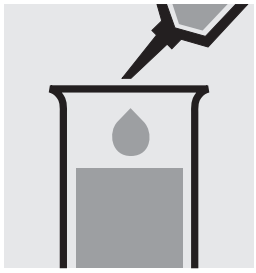
101807

Test

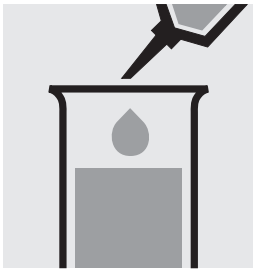
Measuring range:	0.10 – 5.00 mg/l Cl	50-mm cell
	Expression of results also possible in mmol/l.	



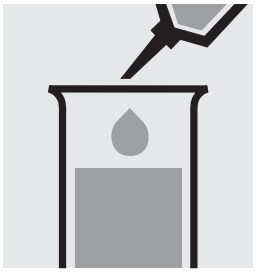
Check the pH of the sample, specified range: pH 3 – 11.
If required, add dilute ammonia solution or nitric acid drop by drop to adjust the pH.



Pipette 0.20 ml each of **Cl-1** into two test tubes.

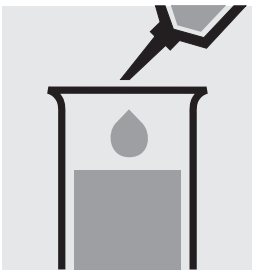


Add to one tube 10 ml of the sample with pipette and mix.

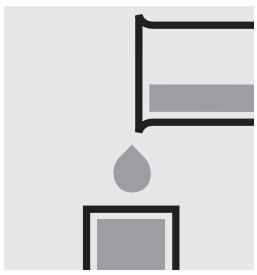


Add to the second tube 10 ml of of distilled water (Water for analysis EMSURE®, Cat.No. 116754, is recommended) with pipette and mix. (Blank cell)

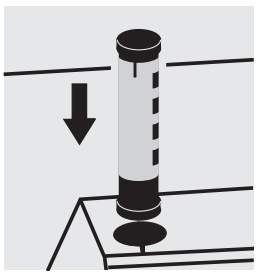
Reaction time: 10 minutes



Add to each tube 0.20 ml of **Cl-2** with pipette and mix.

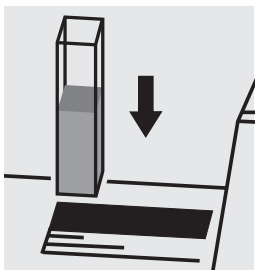


Transfer both solutions into two separate 50-mm-cells.

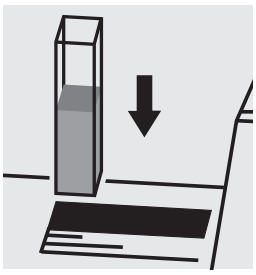


Select method with AutoSelector.

Configure the photometer for blank-measurement.



Place the blank cell into the cell compartment.



Place the cell containing the sample into the cell compartment.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) ready-for-use chloride standard solution Certipur®, Cat.No. 119897, concentration 1000 mg/l Cl^-, can be used after diluting accordingly.

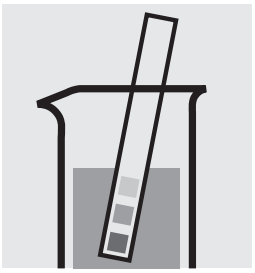
Chlorine

Determination of free chlorine

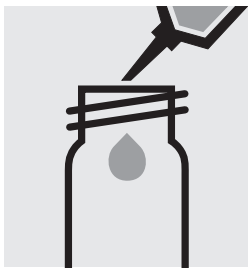
100595

Cell Test

Measuring range:	0.03– 6.00 mg/l Cl_2 Expression of results also possible in mmol/l.

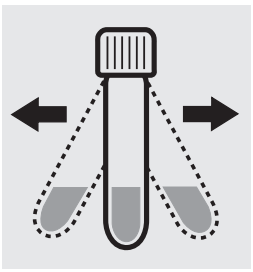


Check the pH of the sample, specified range: pH 4 – 8.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.



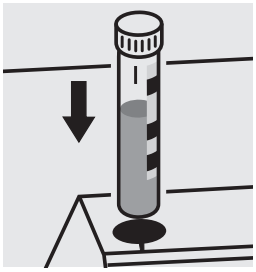
Pipette 5.0 ml of the sample into a round cell.

Add 1 level blue micro-spoon of **Cl_2-1**, close with the screw cap.



Shake the cell vigorously to dissolve the solid substance.

Reaction time: 1 minute



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Important:

Very high chlorine concentrations in the sample produce yellow-colored solutions (measurement solution should be red) and false-low readings are yielded. In such cases the sample must be diluted (plausibility check).

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) a freshly prepared standard solution can be used (see section “Standard solutions”).

Chlorine

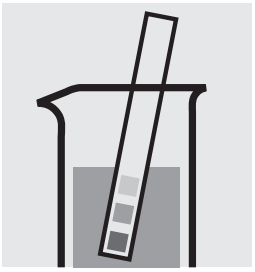
Determination of free chlorine and total chlorine

100597

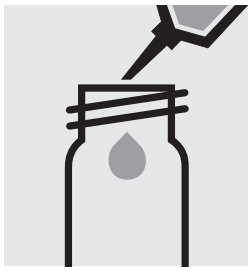
Cell Test

Measuring range:	0.03– 6.00 mg/l Cl_2 Expression of results also possible in mmol/l and also in free Cl_2 [Cl_2(f)], combined Cl_2 [Cl_2(b)], and total Cl_2 [Cl_2(t)].

Determination of free chlorine

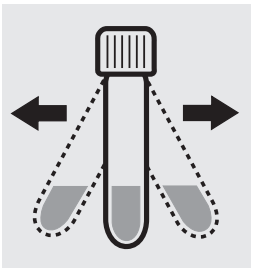


Check the pH of the sample, specified range: pH 4 – 8.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.



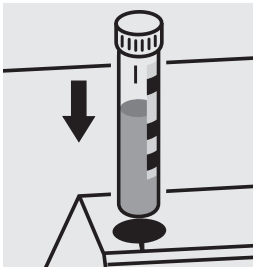
Pipette 5.0 ml of the sample into a round cell.

Add 1 level blue micro-spoon of **Cl_2-1**, close with the screw cap.



Shake the cell vigorously to dissolve the solid substance.

Reaction time: 1 minute



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Determination of total chlorine

Same preparation as described above, add 2 drops of **Cl_2-2**, close the cell with the screw cap, and mix after dissolving solid.

A differentiation between free and combined chlorine [Cl_2(f) and Cl_2(b)] can be performed on the photometer. Prior to measuring, select the differentiation measurement and choose the corresponding citation form. Then measure the free chlorine (result for "free Cl_2" is shown on the display), press enter, remove the cell, add 2 drops of Cl_2-2, close with the screw cap, mix, and measure the total chlorine. The individual measuring values for total and combined chlorine are shown on the display.

Important:

Very high chlorine concentrations in the sample produce yellow-colored solutions (measurement solution should be red) and false-low readings are yielded. In such cases the sample must be diluted (plausibility check).
After each determination of total chlorine rinse the cell with sulfuric acid 25 % and subsequently several times with distilled water.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) a freshly prepared standard solution can be used (see section "Standard solutions").

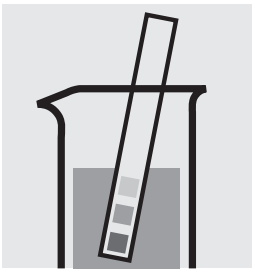
Chlorine

Determination of free chlorine

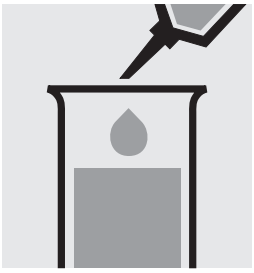
100598

Test

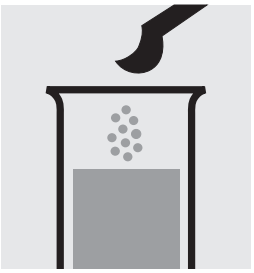
Measuring	0.05 – 6.00	mg/l Cl_2	10-mm cell
range:	0.02 – 3.00	mg/l Cl_2	20-mm cell
	0.010 – 1.000	mg/l Cl_2	50-mm cell
	Expression of results also possible in mmol/l.		



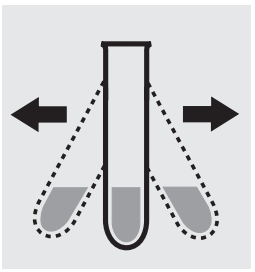
Check the pH of the sample, specified range: pH 4 – 8.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.



Pipette 10 ml of the sample into a test tube.

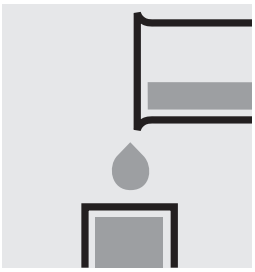


Add 1 level blue micro-spoon of **Cl_2-1**.

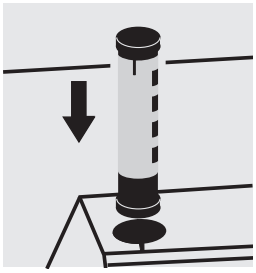


Shake vigorously to dissolve the solid substance.

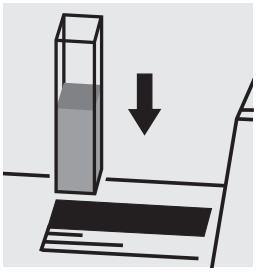
Reaction time: 1 minute



Transfer the solution into a corresponding cell.



Select method with AutoSelector.



Place the cell into the cell compartment.

Important:

Very high chlorine concentrations in the sample produce yellow-colored solutions (measurement solution should be red) and false-low readings are yielded. In such cases the sample must be diluted (plausibility check).

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) a freshly prepared standard solution can be used (see section “Standard solutions”).

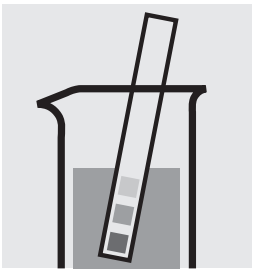
Chlorine

Determination of total chlorine

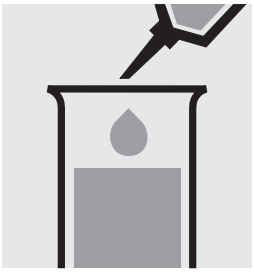
100602

Test

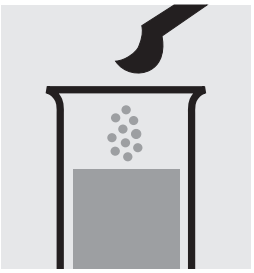
Measuring	0.05 – 6.00	mg/l Cl_2	10-mm cell
range:	0.02 – 3.00	mg/l Cl_2	20-mm cell
	0.010 – 1.000	mg/l Cl_2	50-mm cell
	Expression of results also possible in mmol/l.		



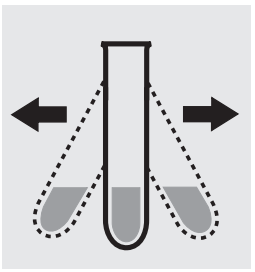
Check the pH of the sample, specified range: pH 4 – 8.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.



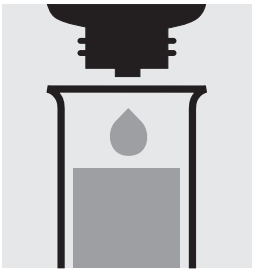
Pipette 10 ml of the sample into a test tube.



Add 1 level blue micro-spoon of **Cl_2-1**.

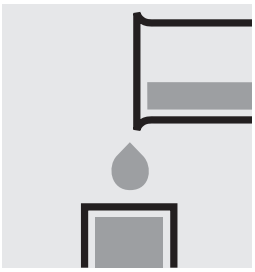


Shake vigorously to dissolve the solid substance.

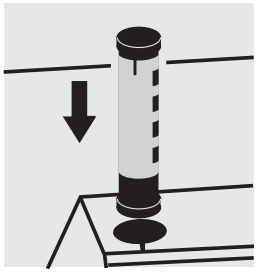


Add 2 drops of **Cl_2-2** and mix.

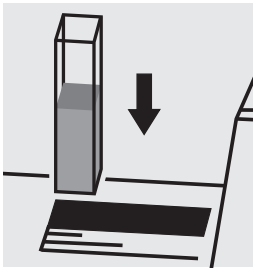
Reaction time:
1 minute



Transfer the solution into a corresponding cell.



Select method with AutoSelector.



Place the cell into the cell compartment.

Important:

Very high chlorine concentrations in the sample produce yellow-colored solutions (measurement solution should be red) and false-low readings are yielded. In such cases the sample must be diluted (plausibility check).
After each determination of total chlorine rinse the cell with sulfuric acid 25 % and subsequently several times with distilled water.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) a freshly prepared standard from Chloramine T GR can be used (see section “Standard solutions”).

Chlorine

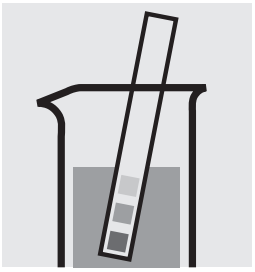
Determination of free chlorine and total chlorine

100599

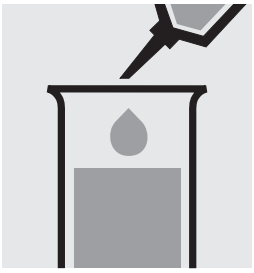
Test

Measuring	0.05 – 6.00	mg/l Cl_2	10-mm cell
range:	0.02 – 3.00	mg/l Cl_2	20-mm cell
	0.010 – 1.000	mg/l Cl_2	50-mm cell
	Expression of results also possible in mmol/l and also in free Cl_2 [Cl_2(f)], combined Cl_2 [Cl_2(b)], and total Cl_2 [Cl_2(t)].		

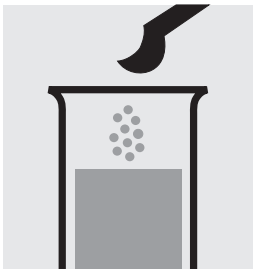
Determination of free chlorine



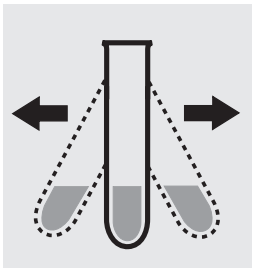
Check the pH of the sample, specified range: pH 4 – 8.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.



Pipette 10 ml of the sample into a test tube.

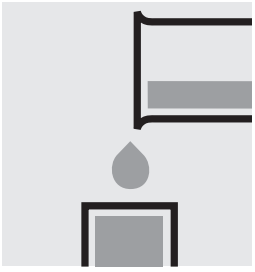


Add 1 level blue micro-spoon of **Cl_2-1**.

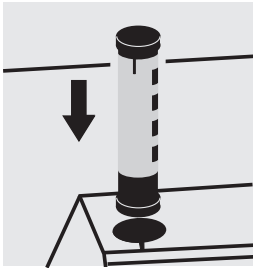


Shake vigorously to dissolve the solid substance.

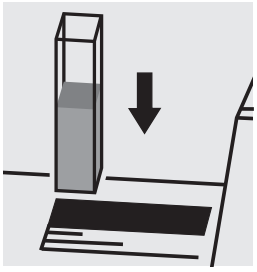
Reaction time: 1 minute



Transfer the solution into a corresponding cell.



Select method with AutoSelector.



Place the cell into the cell compartment.

Determination of total chlorine

Same preparation as described above, add 2 drops of **Cl_2-2** and mix after dissolving solid.

A differentiation between free and combined chlorine [Cl_2(f) and Cl_2(b)] can be performed on the photometer. Prior to measuring, select the differentiation measurement and choose the corresponding citation form. Then measure the free chlorine (result for "free Cl_2" is shown on the display), press enter and measure the total chlorine. The individual measuring values for total and combined chlorine are shown on the display.

Important:

Very high chlorine concentrations in the sample produce yellow-colored solutions (measurement solution should be red) and false-low readings are yielded. In such cases the sample must be diluted (plausibility check).
After each determination of total chlorine rinse the cell with sulfuric acid 25 % and subsequently several times with distilled water.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) a freshly prepared standard solution can be used (see section "Standard solutions").

Chlorine (with liquid reagents)

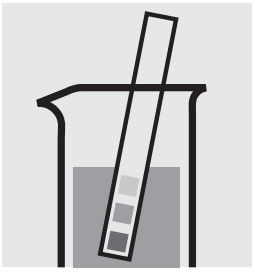
Determination of free chlorine and total chlorine

100086/100087/ 100088

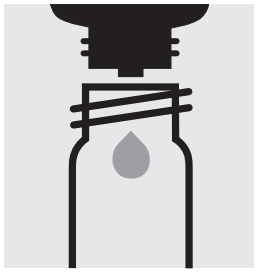
Cell Test

Measuring range:	0.03– 6.00 mg/l Cl_2 Expression of results also possible in mmol/l and also in free Cl_2 [Cl_2(f)], combined Cl_2 [Cl_2(b)], and total Cl_2 [Cl_2(t)].

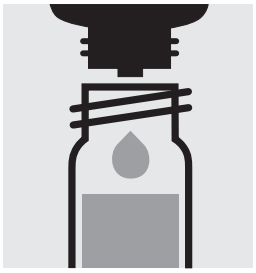
Determination of free chlorine



Check the pH of the sample, specified range: pH 4 – 8.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.



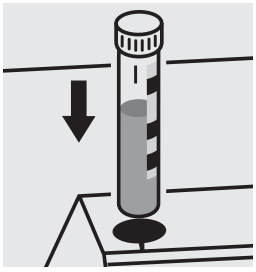
Place 6 drops of **Cl_2-1** into a round cell.



Add 3 drops of **Cl_2-2**, close with the screw cap, and mix.

Add 10 ml of the sample with pipette, close with the screw cap, and mix.

Reaction time: 1 minute



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Determination of total chlorine

Same preparation as described above, add 2 drops of **Cl_2-3**, close with the screw cap, and mix after the end of the reaction time.

A differentiation between free and combined chlorine [Cl_2(f) and Cl_2(b)] can be performed on the photometer. Prior to measuring, select the differentiation measurement and choose the corresponding citation form. Then measure the free chlorine (result for "free Cl_2" is shown on the display), press enter, remove the cell, add 2 drops of Cl_2-3, close with the screw cap, mix, and measure the total chlorine. The individual measuring values for total and combined chlorine are shown on the display.

Important:

Very high chlorine concentrations in the sample produce yellow-colored solutions (measurement solution should be red) and false-low readings are yielded. In such cases the sample must be diluted (plausibility check).
After each determination of total chlorine rinse the cell with sulfuric acid 25 % and subsequently several times with distilled water.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) a freshly prepared standard solution can be used (see section "Standard solutions").

Chlorine (with liquid reagents)

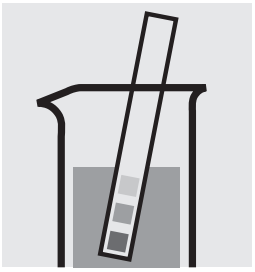
Detemination of free chlorine and total chlorine

100086/100087/ 100088

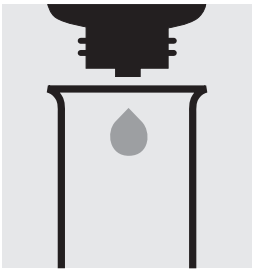
Test

Measuring range:	0.10– 1.00 mg/l Cl_2	50-mm cell
	Expression of results also possible in mmol/l and also in free Cl_2 [Cl_2(f)], combined Cl_2 [Cl_2(b)], and total Cl_2 [Cl_2(t)].	

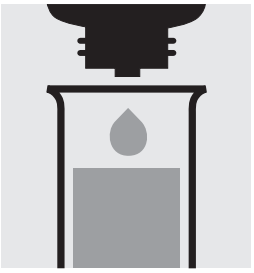
Determination of free chlorine



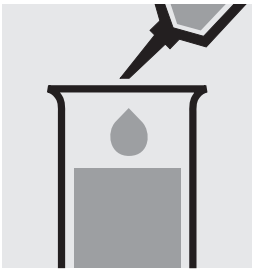
Check the pH of the sample, specified range: pH 4 – 8.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.



Place 6 drops of **Cl_2-1** into a test tube.

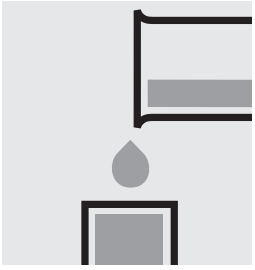


Add 3 drops of **Cl_2-2**, close with the screw cap, and mix.

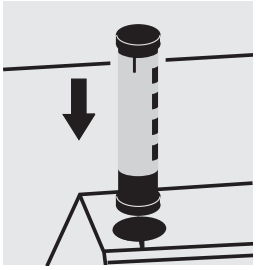


Add 10 ml of the sample with pipette, close with the screw cap, and mix.

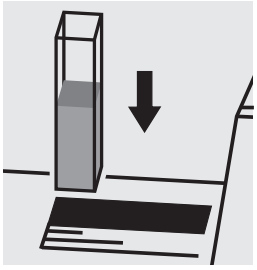
Reaction time: 1 minute



Transfer the solution into a cell.



Select method with AutoSelector.



Place the cell into the cell compartment.

Determination of total chlorine

Same preparation as described above, add 2 drops of **Cl_2-3** and mix after the end of the reaction time.

A differentiation between free and combined chlorine [Cl_2(f) and Cl_2(b)] can be performed on the photometer. Prior to measuring, select the differentiation measurement and choose the corresponding citation form. Then measure the free chlorine (result for "free Cl_2" is shown on the display), press enter, remove the cell, add 2 drops of Cl_2-3, mix using the microspatula, and measure the total chlorine. The individual measuring values for total and combined chlorine are shown on the display.

Important:

Very high chlorine concentrations in the sample produce yellow-colored solutions (measurement solution should be red) and false-low readings are yielded. In such cases the sample must be diluted (plausibility check).
After each determination of total chlorine rinse the cell with sulfuric acid 25 % and subsequently several times with distilled water.

Quality assurance:

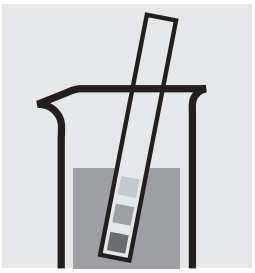
To check the measurement system (test reagents, measurement device, and handling) a freshly prepared standard solution can be used (see section "Standard solutions").

Chlorine dioxide

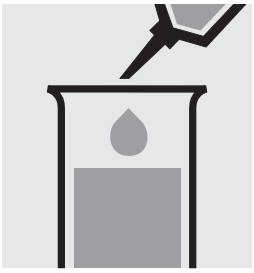
100608

Test

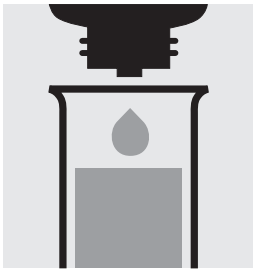
Measuring	0.10 – 10.00 mg/l ClO_2	10-mm cell
range:	0.05 – 5.00 mg/l ClO_2	20-mm cell
	0.020 – 2.000 mg/l ClO_2	50-mm cell
	Expression of results also possible in mmol/l.	



Check the pH of the sample, specified range: pH 4 – 8.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.

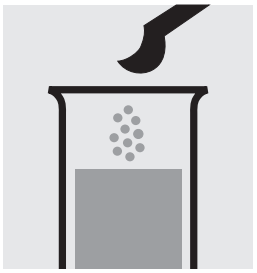


Pipette 10 ml of the sample into a test tube.

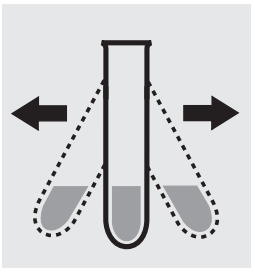


Add 2 drops of **ClO_2-1** and mix.

Reaction time:
2 minutes

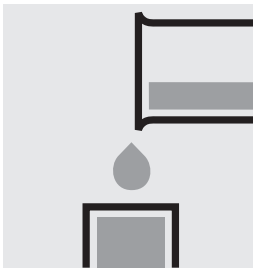


Add 1 level blue micro-spoon of **ClO_2-2.**

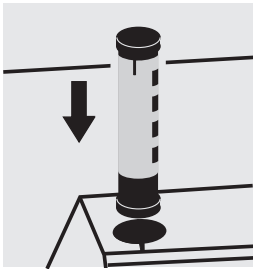


Shake vigorously to dissolve the solid substance.

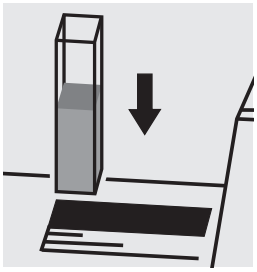
Reaction time:
1 minute



Transfer the solution into a corresponding cell.



Select method with AutoSelector.



Place the cell into the cell compartment.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) a freshly prepared standard solution can be used (see section “Standard solutions”).

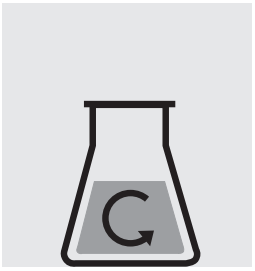
Chlorophyll

Determination of chlorophyll-a and phaeophytin-a

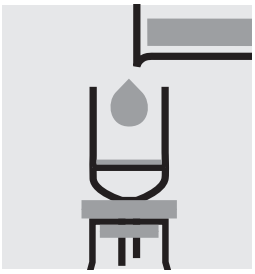
corresponds to **DIN 38412** and **ISO 10260**

Application

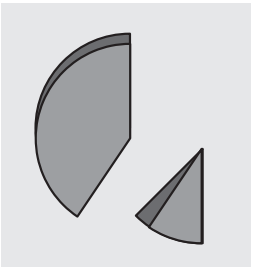
Measuring	depending on the ratio of original sample to extract	10-mm cell	Method No. 2509
range:	in µg/l Chl-a or Phaeo	20-mm cell	Method No. 2510
		50-mm cell	Method No. 2511
Attention!	The measurement is carried out in a corresponding rectangular cell against a blank, prepared from ethanol (w = 90 %).		



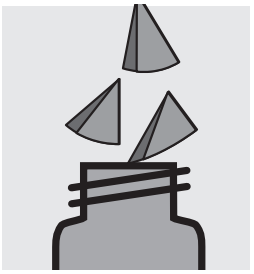
Sufficiently homogenize 0.5 - 2 l of sample. **Note the sample volume.**



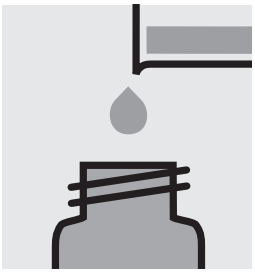
Filter the sample through a suitable filter (e.g. glass-fibre filter).



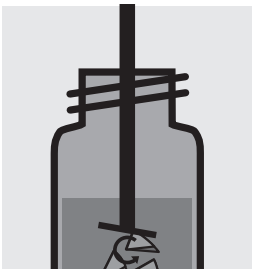
Fold the loaded filter and tear into small pieces.



Place the pieces of the filter in an extraction vessel (e.g. 100-ml amber glass bottle).

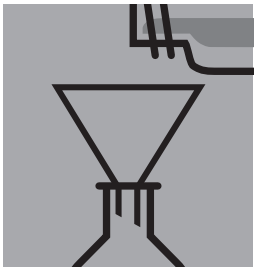


Add approx. 30 ml of boiling **ethanol** (w = 90 %) and allow to cool to room temperature.

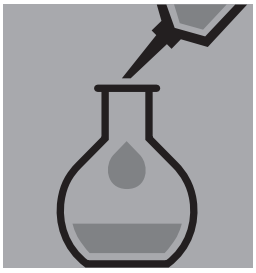


Disintegrate the filter in the homogenizer. Rinse together with a small portion of ethanol.

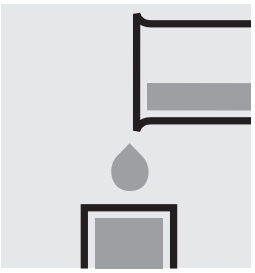
Allow to stand for 6 - 24 hours for the extraction to take place.



Filter the extract **protected from light** through a paper filter (“Blauband”) into a volumetric flask (for DIN 38412: 100 ml). Rinse the filter with a small portion of ethanol.

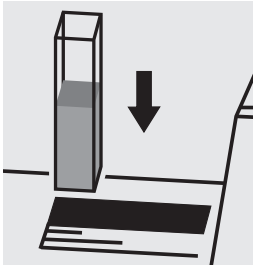


Make the contents of the volumetric flask up to the mark with ethanol, keeping them **protected from light** in the process!

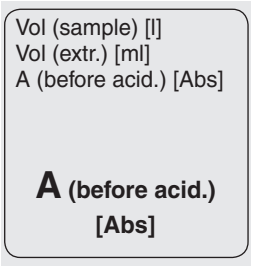


Transfer the solution into a corresponding cell.

Select method no. **2509**, **2510**, or **2511**.
Enter the volumes of the original sample and extract (volumetric flask).



Place the cell into the cell compartment.



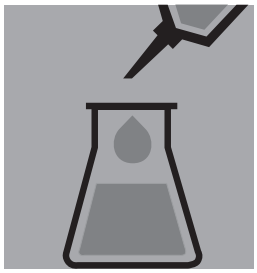
Chlorophyll

Determination of chlorophyll-a and phaeophytin-a

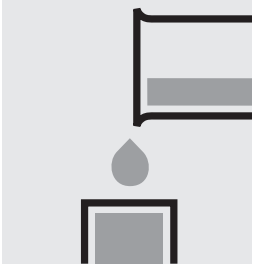
corresponds to **DIN 38412** and **ISO 10260**

Application

Differentiation (chlorophyll-a - phaeophytin-a):

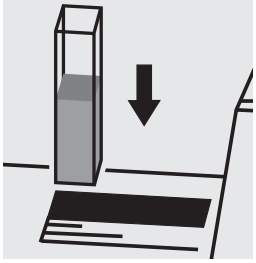


To differentiate the chlorophyll-a content and for the determination of the phaeophytin-a content, acidify a portion of the extract with **hydrochloric acid 2 mol/l Titripur®** (Cat. No. 109063) (0.3 ml per 100 ml of extract).



Transfer the solution into a corresponding cell.

START
ENTER



Place the cell into the cell compartment and measure anew.

Vol (sample) [l]
Vol (extr.) [ml]
A (before acid.) [Abs]
A (after acid.) [Abs]
Chl-a [µg/l]

Chl-a [µg/l]

START
ENTER

Vol (sample) [l]
Vol (extr.) [ml]
A (before acid.) [Abs]
A (after acid.) [Abs]
Chl-a [µg/l]
Phaeo [µg/l]

Phaeo [µg/l]

Important:

The exact procedure as well as further details on the method used can be found in the corresponding application. This application can be downloaded directly at www.analytical-test-kits.com.

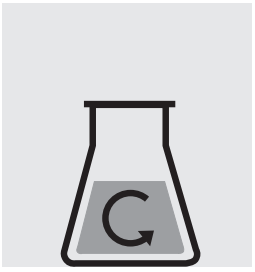
Chlorophyll

Determination of chlorophyll-a and phaeophytin-a

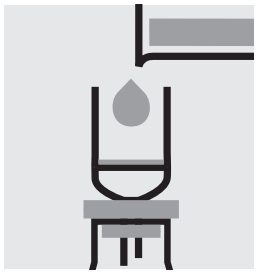
analogous to **APHA 10200-H**

Application

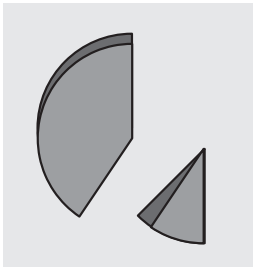
Measuring	depending on the ratio of original sample to extract	10-mm cell	Method No. 2504
range:	in mg/m^3 Chl-a or Phaeo-a	20-mm cell	Method No. 2505
		50-mm cell	Method No. 2506
Attention!	The measurement is carried out in a corresponding rectangular cell against a blank, prepared from extracting agent.		



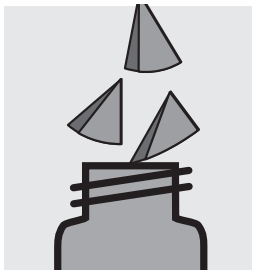
Sufficiently homogenize the sample. **Note the sample volume.**



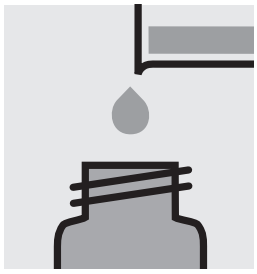
Filter the sample through a suitable filter (e.g. glass-fibre filter).



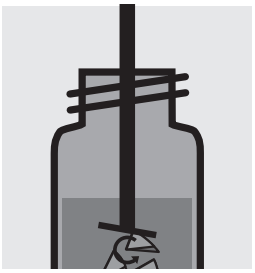
Fold the loaded filter and tear into small pieces.



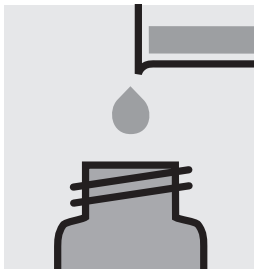
Place the pieces of the filter in an extraction vessel (**protected from light**).



Add 2 - 3 ml of **extracting agent**.

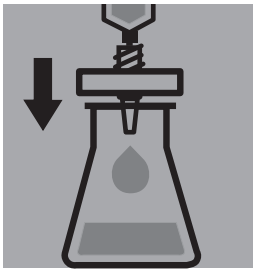


Disintegrate the filter in the homogenizer.

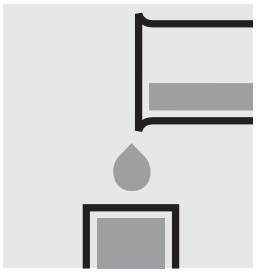


Make up to 10 ml with **extracting agent**.

Allow to stand at +4 °C for at least 2 hours for the extraction to take place.

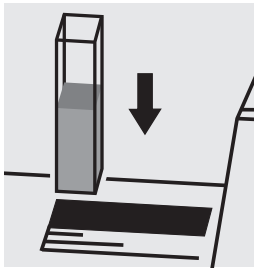


Filter the extract **protected from light** through a suitable filter.

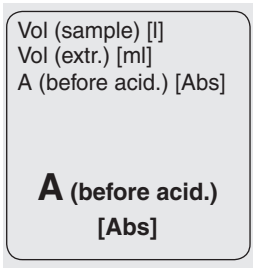


Transfer the solution into a corresponding cell.

Select method no. **2504**, **2505**, or **2506**.
Enter the volumes of the original sample and extract (here: 10 ml).



Place the cell into the cell compartment.



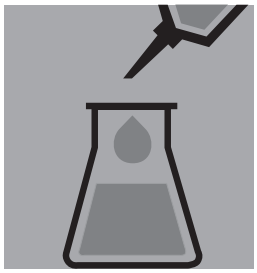
Chlorophyll

Determination of chlorophyll-a and phaeophytin-a

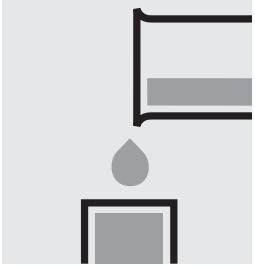
analogous to **APHA 10200-H**

Application

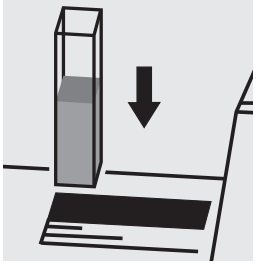
Differentiation (chlorophyll-a - phaeophytin-a):



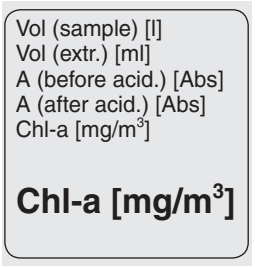
To differentiate the chlorophyll-a content and for the determination of the phaeophytin-a content, acidify a portion of the extract with **hydrochloric acid 0.1 mol/l Titripur®** (Cat. No. 109060) (0.15 ml per 5 ml of extract).

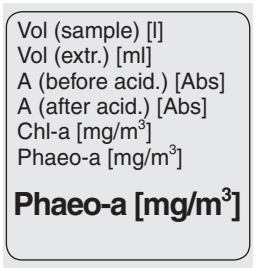


Transfer the solution into a corresponding cell.



Place the cell into the cell compartment and measure anew.





Important:

The exact procedure and the composition and preparation of the extraction agent used are given in the corresponding application, which also includes further information on the method employed. This application can be downloaded directly at www.analytical-test-kits.com.

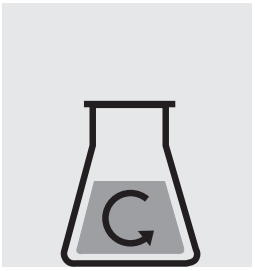
Chlorophyll

Determination of chlorophyll-a and phaeophytin-a

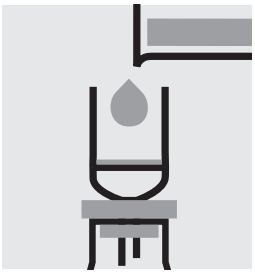
analogous to **ASTM D3731 - 87**

Application

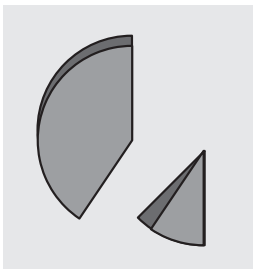
Measuring	depending on the ratio of original sample to extract	10-mm cell	Method No. 2504
range:	in mg/m^3 Chl-a or Phaeo-a	20-mm cell	Method No. 2505
		50-mm cell	Method No. 2506
Attention!	The measurement is carried out in a corresponding rectangular cell against a blank, prepared from extracting agent.		



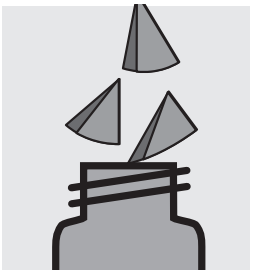
Homogenize the sample, stabilized with magnesiumcarbonate, to a sufficient degree. **Note the sample volume.**



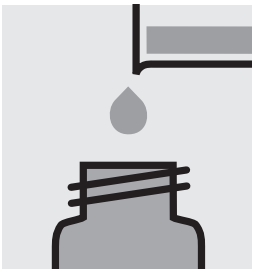
Filter the sample through a suitable filter (e.g. glass-fibre filter).



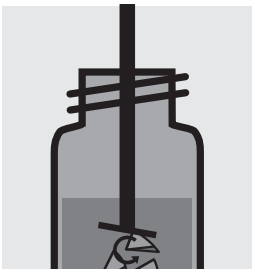
Fold the loaded filter and tear into small pieces.



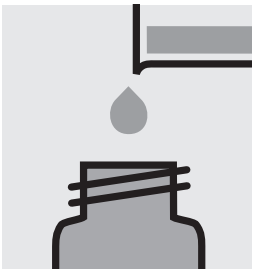
Place the pieces of the filter in an extraction vessel (**protected from light**).



Add 2 - 3 ml of **extracting agent**.

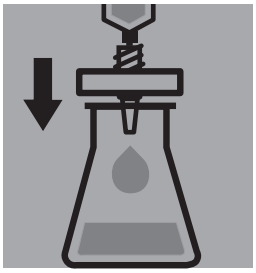


Disintegrate the filter in the homogenizer.

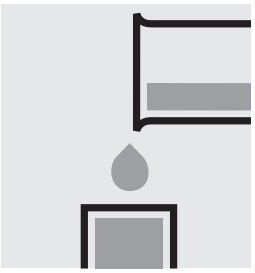


Make up to 10 ml with **extracting agent**.

Allow to stand at +4 °C for 0.25 - 24 hours for the extraction to take place.

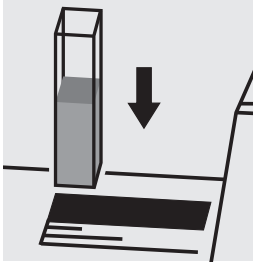


Filter the extract **protected from light** through a suitable filter.

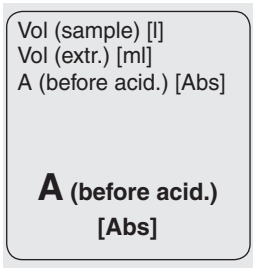


Transfer the solution into a corresponding cell.

Select method no. **2504**, **2505**, or **2506**.
Enter the volumes of the original sample and extract (here: 10 ml).



Place the cell into the cell compartment.



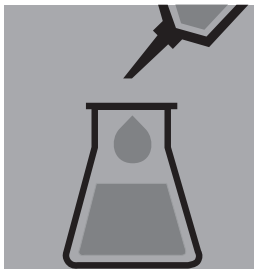
Chlorophyll

Determination of chlorophyll-a and phaeophytin-a

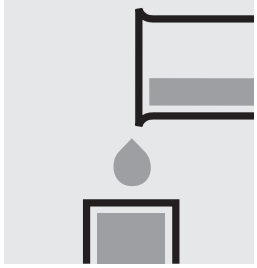
analogous to **ASTM D3731 - 87**

Application

Differentiation (chlorophyll-a - phaeophytin-a):

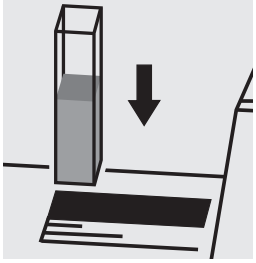


To differentiate the chlorophyll-a content and for the determination of the phaeophytin-a content, acidify a portion of the extract with **hydrochloric acid 1 mol/l Titripur®** (Cat. No. 109057) (50 µl per 5 ml of extract).



Transfer the solution into a corresponding cell.

START
ENTER



Place the cell into the cell compartment and measure anew.

Vol (sample) [l]
Vol (extr.) [ml]
A (before acid.) [Abs]
A (after acid.) [Abs]
Chl-a [mg/m^3]

Chl-a [mg/m^3]

START
ENTER

Vol (sample) [l]
Vol (extr.) [ml]
A (before acid.) [Abs]
A (after acid.) [Abs]
Chl-a [mg/m^3]
Phaeo-a [mg/m^3]

Phaeo-a [mg/m^3]

Important:

The exact procedure and the composition and preparation of the extraction agent used are given in the corresponding application, which also includes further information on the method employed. This application can be downloaded directly at www.analytical-test-kits.com.

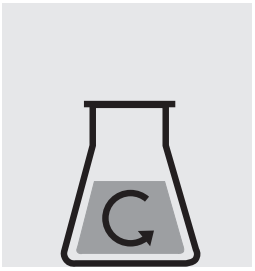
Chlorophyll-a, -b, -c

(Trichromatic Method)

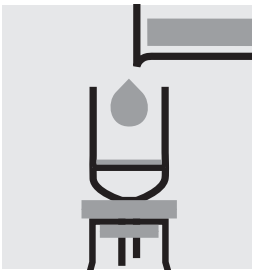
analogous to **APHA 10200-H**

Application

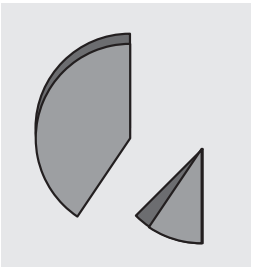
Measuring	depending on the ratio of original sample to extract	10-mm cell	Method No. 2507
range:	in mg/m^3 Chl-a, -b, -c	50-mm cell	Method No. 2508
Attention!	The measurement is carried out in a corresponding rectangular cell against a blank, prepared from extracting agent.		



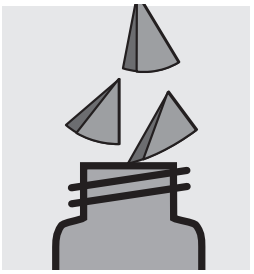
Sufficiently homogenize the sample. **Note the sample volume.**



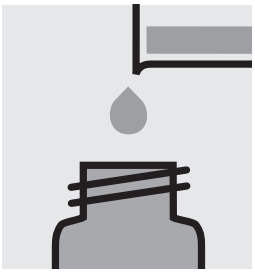
Filter the sample through a suitable filter (e.g. glass-fibre filter).



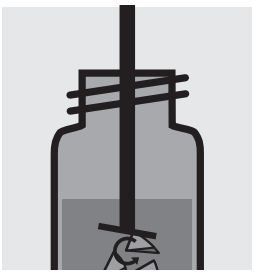
Fold the loaded filter and tear into small pieces.



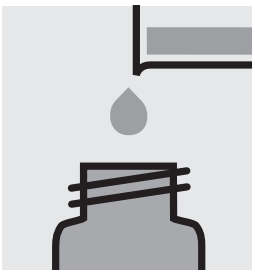
Place the pieces of the filter in an extraction vessel (**protected from light**).



Add 2 - 3 ml of **extracting agent**.

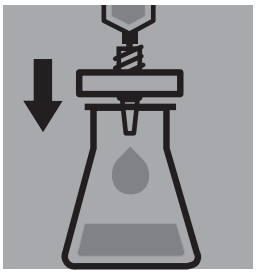


Disintegrate the filter in the homogenizer.

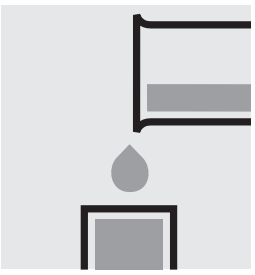


Make up to 10 ml with **extracting agent**.

Allow to stand at +4 °C for at least 2 hours for the extraction to take place.

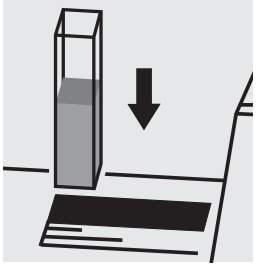


Filter the extract **protected from light** through a suitable filter.

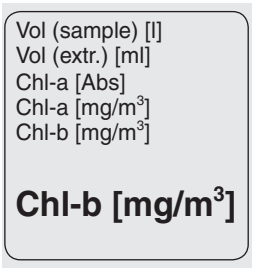


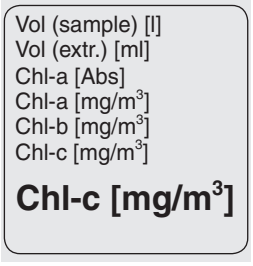
Transfer the solution into a corresponding cell.

Select method no. **2507** or **2508**.
Enter the volumes of the original sample and extract (here: 10 ml).



Place the cell into the cell compartment.





Important:

The exact procedure and the composition and preparation of the extraction agent used are given in the corresponding application, which also includes further information on the method employed. This application can be downloaded directly at www.analytical-test-kits.com.

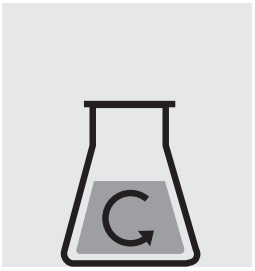
Chlorophyll-a, -b, -c

(Trichromatic Method)

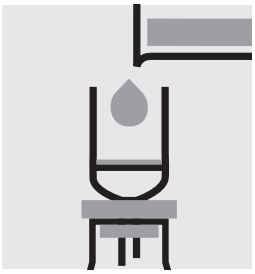
analogous to **ASTM D3731 - 87**

Application

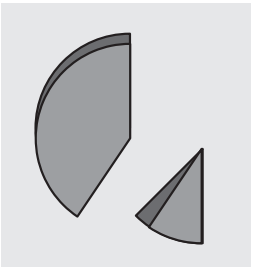
Measuring	depending on the ratio of original sample to extract	10-mm cell	Method No. 2507
range:	in mg/m^3 Chl-a, -b, -c	50-mm cell	Method No. 2508
Attention!	The measurement is carried out in a corresponding rectangular cell against a blank, prepared from extracting agent.		



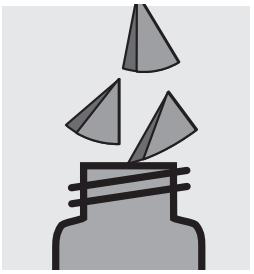
Homogenize the sample, stabilized with magnesiumcarbonate, to a sufficient degree. **Note the sample volume.**



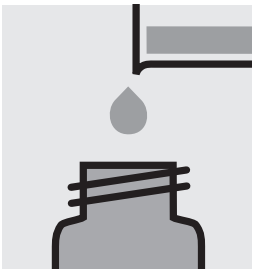
Filter the sample through a suitable filter (e.g. glass-fibre filter).



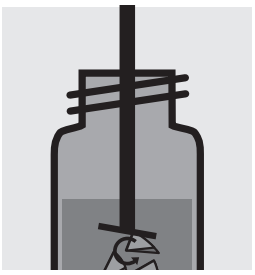
Fold the loaded filter and tear into small pieces.



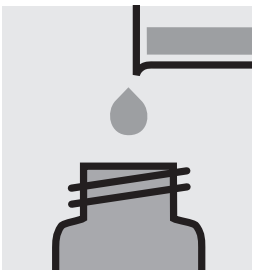
Place the pieces of the filter in an extraction vessel (**protected from light**).



Add 2 - 3 ml of **extracting agent**.

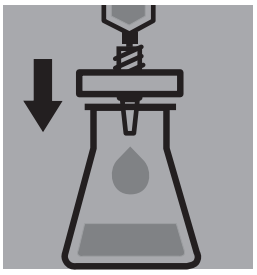


Disintegrate the filter in the homogenizer.

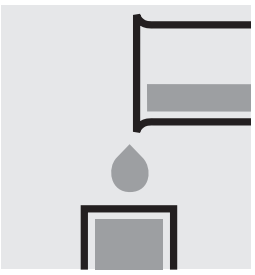


Make up to 10 ml with **extracting agent**.

Allow to stand at +4 °C for 0.25 - 24 hours for the extraction to take place.

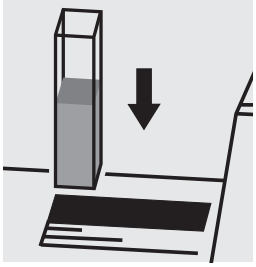


Filter the extract **protected from light** through a suitable filter.

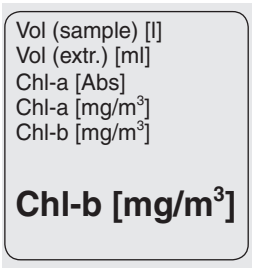


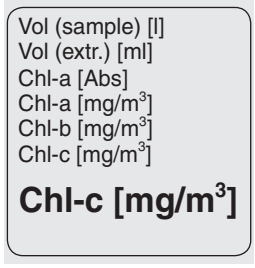
Transfer the solution into a corresponding cell.

Select method no. **2507** or **2508**.
Enter the volumes of the original sample and extract (here: 10 ml).



Place the cell into the cell compartment.





Important:

The exact procedure and the composition and preparation of the extraction agent used are given in the corresponding application, which also includes further information on the method employed. This application can be downloaded directly at www.analytical-test-kits.com.

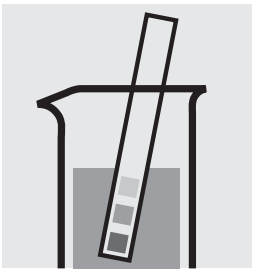
Chromate

Determination of chromium(VI)

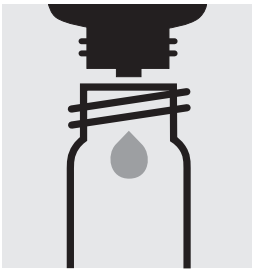
114552

Cell Test

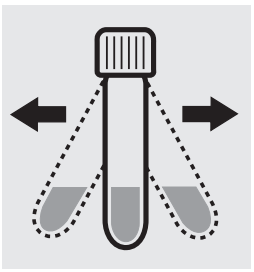
Measuring range:	0.05 – 2.00 mg/l Cr
	0.11 – 4.46 mg/l CrO_4
	Expression of results also possible in mmol/l.



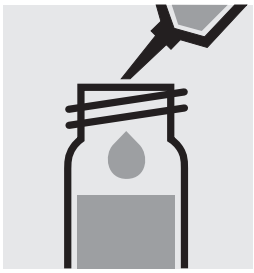
Check the pH of the sample, specified range: pH 1 – 9.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.



Add 6 drops of **Cr-3K** into a reaction cell, close with the screw cap.

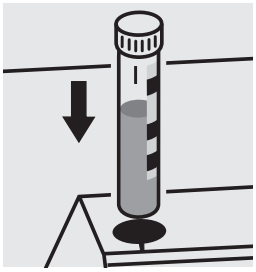


Shake the cell vigorously to dissolve the solid substance and leave to stand for **1 minute**.



Add 5.0 ml of the sample with pipette, close the cell with the screw cap, and mix.

Reaction time: 1 minute



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) ready-for-use chromate standard solution Certipur®, Cat.No. 119780, concentration 1000 mg/l CrO_4^{2-}, can be used after diluting accordingly.

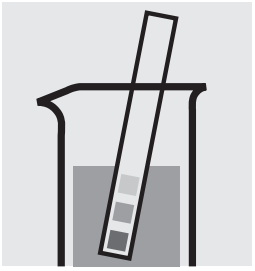
Chromate

Determination of total chromium
= sum of chromium(VI) and chromium(III)

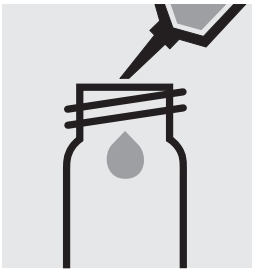
114552

Cell Test

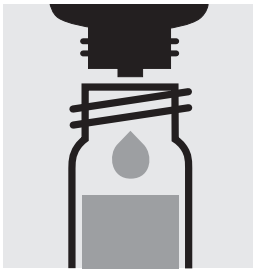
Measuring range:	0.05 – 2.00 mg/l Cr
	0.11 – 4.46 mg/l CrO_4
	Expression of results also possible in mmol/l and also in Cr total (Σ Cr), Cr(III), and Cr(VI).



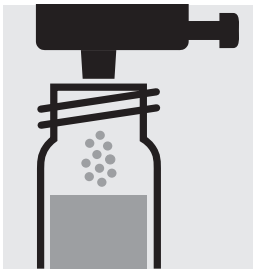
Check the pH of the sample, specified range: pH 1 – 9.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.



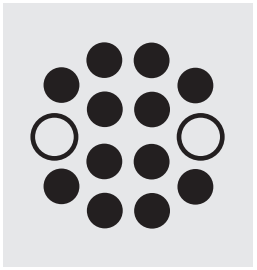
Pipette 10 ml of the sample into an empty round cell (Empty cells, Cat.No. 114724).



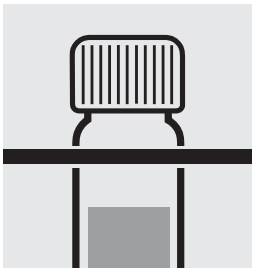
Add 1 drop of **Cr-1K**, close with the screw cap, and mix.



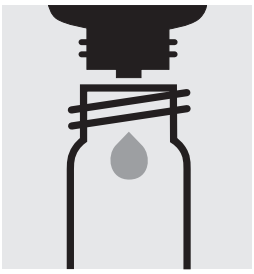
Add 1 dose of **Cr-2K** using the blue dose-metering cap, close the reaction cell with the screw cap.



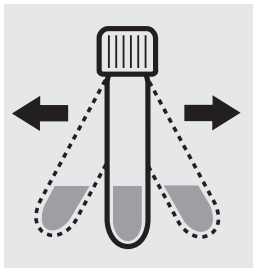
Heat the cell in the thermoreactor at 120 °C (100 °C) for 1 hour.



Remove the cell from the thermoreactor and place in a test-tube rack to cool to room temperature: **pretreated sample**.



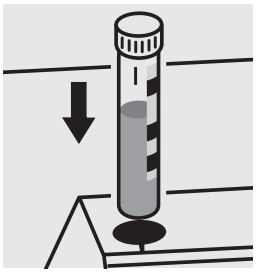
Add 6 drops of **Cr-3K** into a reaction cell, close the cell with the screw cap.



Shake the cell vigorously to dissolve the solid substance and leave to stand for **1 minute**.

Add 5.0 ml of the **pretreated sample** with pipette, close with the screw cap, and mix.

Reaction time:
1 minute



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

A differentiation between chromium(VI) and chromium(III) can be performed on the photometer. Prior to measuring, select the differentiation measurement and choose the corresponding citation form. Then measure the total chromium (result for "Cr total" is shown on the display), press enter and measure the chromium(VI) (see analytical procedure for chromium(VI)). The individual measuring values for Cr VI and Cr III are shown on the display.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) ready-for-use chromate standard solution Certipur®, Cat.No. 119780, concentration 1000 mg/l CrO_4^{2-}, can be used after diluting accordingly.

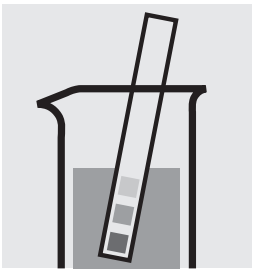
Chromate

Determination of chromium(VI)

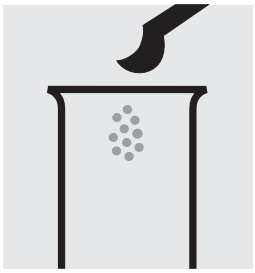
114758

Test

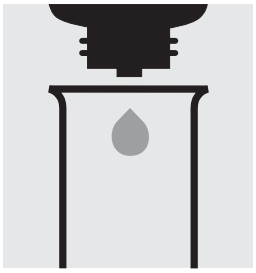
Measuring	0.05 – 3.00 mg/l Cr	0.11 – 6.69 mg/l CrO_4	10-mm cell
range:	0.03 – 1.50 mg/l Cr	0.07 – 3.35 mg/l CrO_4	20-mm cell
	0.010 – 0.600 mg/l Cr	0.02 – 1.34 mg/l CrO_4	50-mm cell
	Expression of results also possible in mmol/l.		



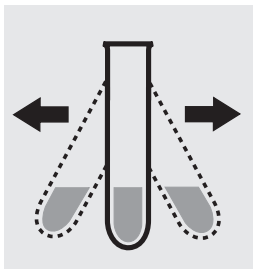
Check the pH of the sample, specified range: pH 1 – 9.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.



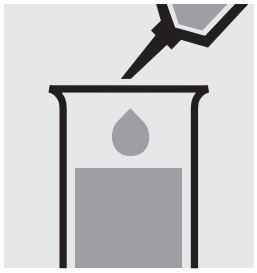
Place 1 level grey microspoon of **Cr-1** into a dry test tube.



Add 6 drops of **Cr-2**.

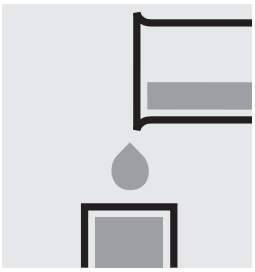


Shake the test tube vigorously to dissolve the solid substance.

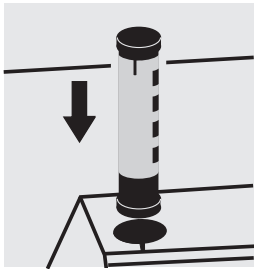


Add 5.0 ml of the sample with pipette and mix.

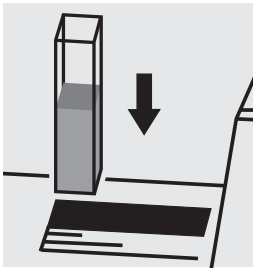
Reaction time:
1 minute



Transfer the solution into a corresponding cell.



Select method with AutoSelector.



Place the cell into the cell compartment.

Important:

For the determination of **total chromium = sum of chromium(VI) and chromium(III)** a pretreatment with Crack Set 10C, Cat.No. 114688, or Crack Set 10, Cat.No. 114687 and thermoreactor is necessary.

Result can be expressed as sum of chromium (Σ Cr).

To measure in the 50-mm cell, the sample volume and the volume of the reagents have to be doubled for each. Alternatively, the semi-microcell, Cat.No. 173502, can be used.

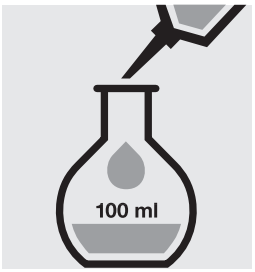
Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) ready-for-use chromate standard solution Certipur®, Cat.No. 119780, concentration 1000 mg/l CrO_4^{2-}, can be used after diluting accordingly.

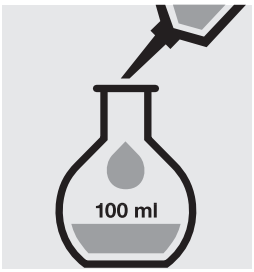
Chromium in electroplating baths

Inherent color

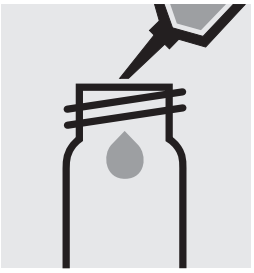
Measuring	20 – 400	g/l CrO_3	10-mm cell
range:	10 – 200	g/l CrO_3	20-mm cell
	4.0 – 80.0	g/l CrO_3	50-mm cell



Pipette 5.0 ml of the sample into a 100-ml volumetric flask, fill to the mark with distilled water and mix thoroughly.

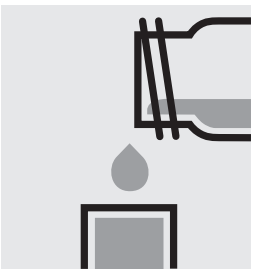


Pipette 4.0 ml of the dilute sample into a 100-ml volumetric flask, fill to the mark with distilled water and mix thoroughly.

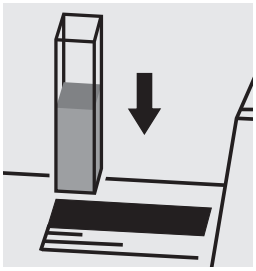


Pipette 5.0 ml of the 1:500 dilute sample into an empty round cell (Empty cells, Cat. No. 114724).

Add 5.0 ml of **sulfuric acid 40 %**, close the cell with the screw cap, and mix.



Transfer the solution into a corresponding rectangular cell.

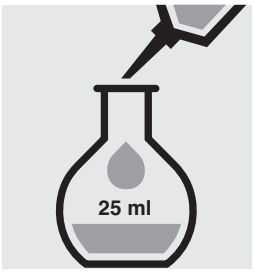


Place the cell into the cell compartment. Select method no. **20**.

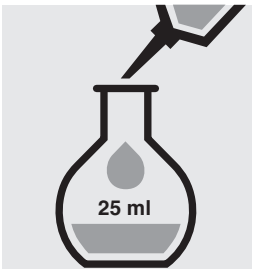
Cobalt in water

Application

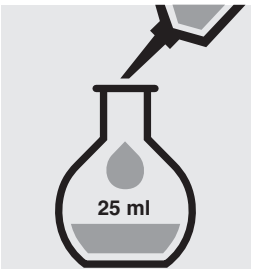
Measuring range:	0.5 – 10.0 mg/l Co 10-mm cell
Attention!	The measurement is carried out at 495 nm in a 10-mm rectangular cell against a blank, prepared from distilled water (Water for analysis EMSURE®, Cat.No. 116754, is recommended) and the reagents in an analogous manner.



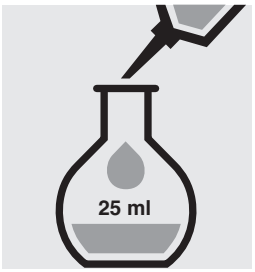
Pipette 4.0 ml of the sample into a 25-ml volumetric flask, fill to the mark with distilled water and mix thoroughly.



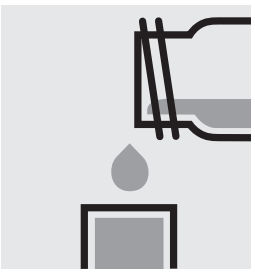
Add 0.25 ml of **reagent 1** with pipette.



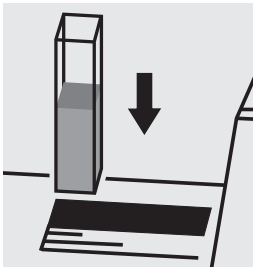
Add 2.0 ml of **reagent 2** with pipette.



Add 1.0 ml of **reagent 3** with pipette, fill to the mark with distilled water, and mix thoroughly.



Transfer the solution into a rectangular cell.



Place the cell into the cell compartment. Select method no. **305**.

Important:

The exact composition and preparation of the reagents 1, 2, and 3 used are given in the corresponding application, which also includes further information on the method employed. This application can be downloaded directly at www.analytical-test-kits.com.

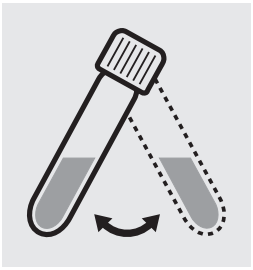
COD

Chemical Oxygen Demand

114560

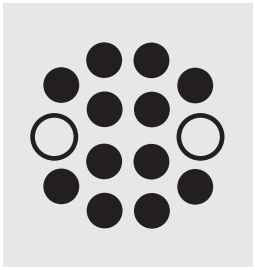
Cell Test

Measuring range:	4.0 – 40.0 mg/l COD or O_2 Expression of results also possible in mmol/l.

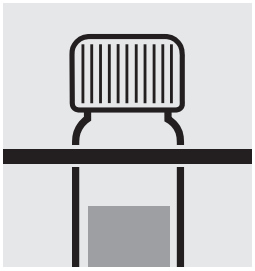


Suspend the bottom sediment in the cell by swirling.

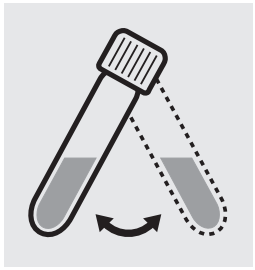
Carefully pipette 3.0 ml of the sample into a reaction cell, close tightly with the screw cap, and mix vigorously. **Caution, the cell becomes hot!**



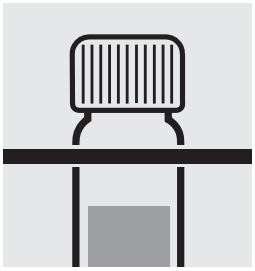
Heat the reaction cell in the thermoreactor at 148 °C for 2 hours.



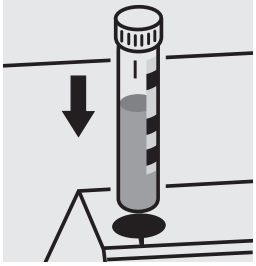
Remove the cell from the thermoreactor and place in a test-tube rack to cool.



Swirl the cell after 10 minutes.



Replace the cell in the rack for complete cooling to room temperature. **Very important!**



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) we recommended to use Spectroquant® CombiCheck 50, Cat.No. 114695, or the Standard solution for photometric applications, CRM, Cat.No. 125028.

To check for sample-dependent effects the use of addition solutions (e.g. in CombiCheck 50) is highly recommended.

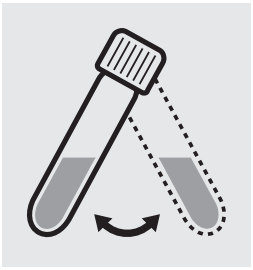
COD

Chemical Oxygen Demand

101796

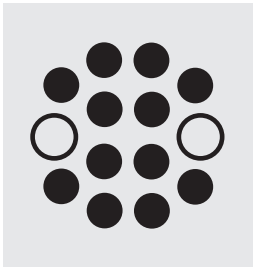
Cell Test

Measuring range:	5.0 – 80.0 mg/l COD or O_2 Expression of results also possible in mmol/l.

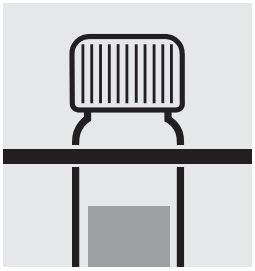


Suspend the bottom sediment in the cell by swirling.

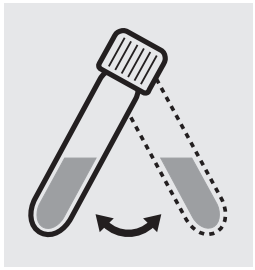
Carefully pipette 2.0 ml of the sample into a reaction cell, close tightly with the screw cap, and mix vigorously.
Caution, the cell becomes hot!



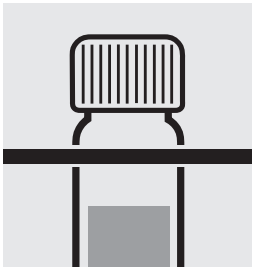
Heat the reaction cell in the thermoreactor at 148 °C for 2 hours.



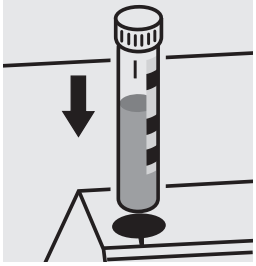
Remove the cell from the thermoreactor and place in a test-tube rack to cool.



Swirl the cell after 10 minutes.



Replace the cell in the rack for complete cooling to room temperature.
Very important!



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) we recommended to use Spectroquant® CombiCheck 50, Cat.No. 114695, or the Standard solution for photometric applications, CRM, Cat.No. 125028.

To check for sample-dependent effects the use of addition solutions (e.g. in CombiCheck 50) is highly recommended.

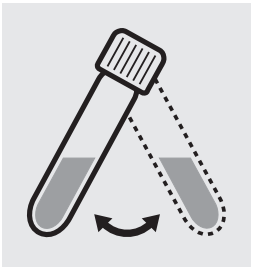
COD

Chemical Oxygen Demand

114540

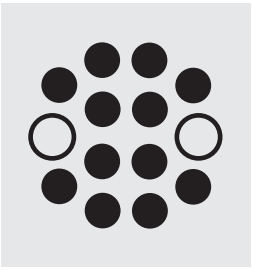
Cell Test

Measuring range:	10 – 150 mg/l COD or O_2 Expression of results also possible in mmol/l.

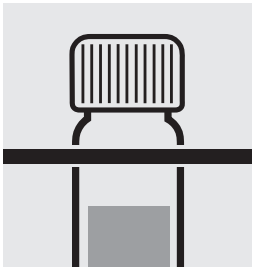


Suspend the bottom sediment in the cell by swirling.

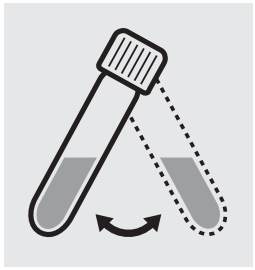
Carefully pipette 3.0 ml of the sample into a reaction cell, close tightly with the screw cap, and mix vigorously. **Caution, the cell becomes hot!**



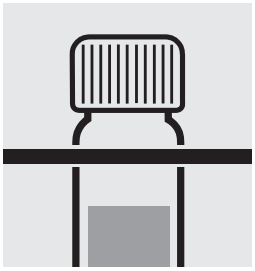
Heat the reaction cell in the thermoreactor at 148 °C for 2 hours.



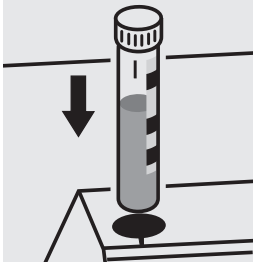
Remove the cell from the thermoreactor and place in a test-tube rack to cool.



Swirl the cell after 10 minutes.



Replace the cell in the rack for complete cooling to room temperature. **Very important!**



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) we recommended to use Spectroquant® CombiCheck 10, Cat.No. 114676, or the Standard solution for photometric applications, CRM, Cat.No. 125029.

To check for sample-dependent effects the use of addition solutions (e.g. in CombiCheck 10) is highly recommended.

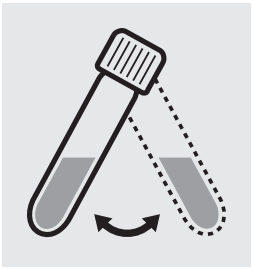
COD

Chemical Oxygen Demand

114895

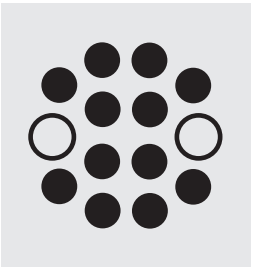
Cell Test

Measuring range:	15 – 300 mg/l COD or O_2 Expression of results also possible in mmol/l.

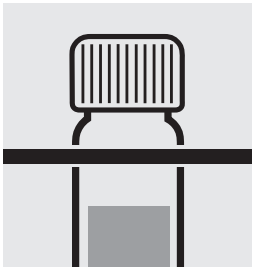


Suspend the bottom sediment in the cell by swirling.

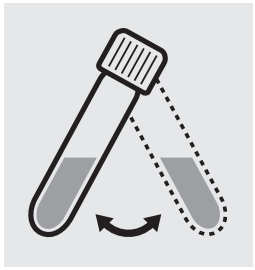
Carefully pipette 2.0 ml of the sample into a reaction cell, close tightly with the screw cap, and mix vigorously. **Caution, the cell becomes hot!**



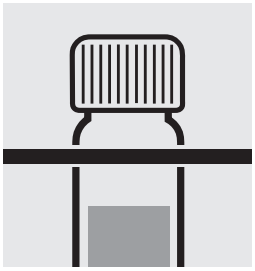
Heat the reaction cell in the thermoreactor at 148 °C for 2 hours.



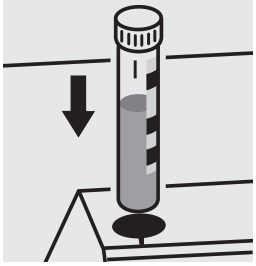
Remove the cell from the thermoreactor and place in a test-tube rack to cool.



Swirl the cell after 10 minutes.



Replace the cell in the rack for complete cooling to room temperature. **Very important!**



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) we recommended to use Spectroquant® CombiCheck 60, Cat.No. 114696, or the Standard solution for photometric applications, CRM, Cat.No. 125029 and 125030.

To check for sample-dependent effects the use of addition solutions (e.g. in CombiCheck 60) is highly recommended.

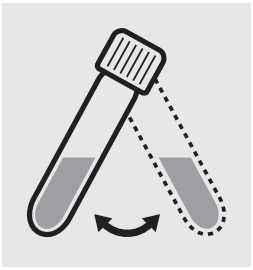
COD

Chemical Oxygen Demand

114690

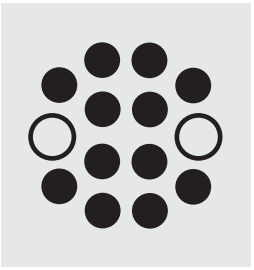
Cell Test

Measuring range:	50 – 500 mg/l COD or O_2 Expression of results also possible in mmol/l.

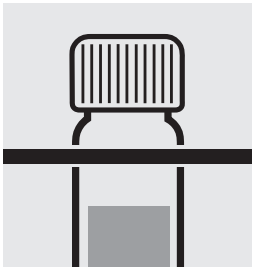


Suspend the bottom sediment in the cell by swirling.

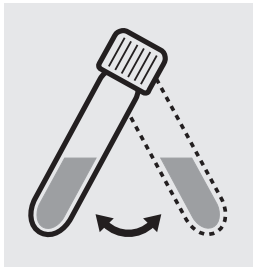
Carefully pipette 2.0 ml of the sample into a reaction cell, close tightly with the screw cap, and mix vigorously. **Caution, the cell becomes hot!**



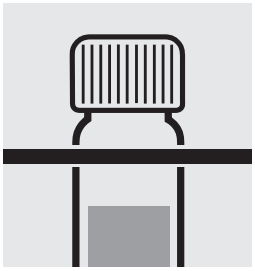
Heat the reaction cell in the thermoreactor at 148 °C for 2 hours.



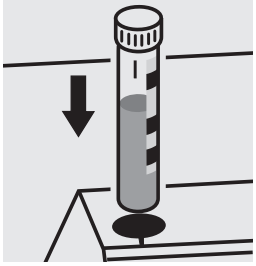
Remove the cell from the thermoreactor and place in a test-tube rack to cool.



Swirl the cell after 10 minutes.



Replace the cell in the rack for complete cooling to room temperature. **Very important!**



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) we recommended to use Spectroquant® CombiCheck 60, Cat.No. 114696, or the Standard solution for photometric applications, CRM, Cat.No. 125029, 125030, and 125031.

To check for sample-dependent effects the use of addition solutions (e.g. in CombiCheck 60) is highly recommended.

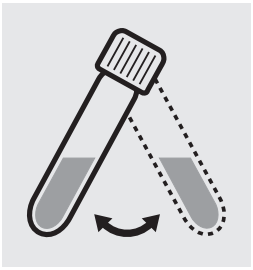
COD

Chemical Oxygen Demand

114541

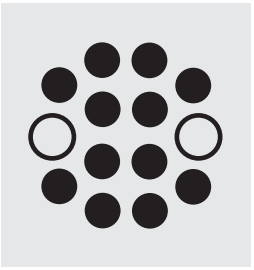
Cell Test

Measuring range:	25 – 1500 mg/l COD or O_2 Expression of results also possible in mmol/l.

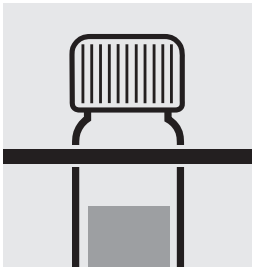


Suspend the bottom sediment in the cell by swirling.

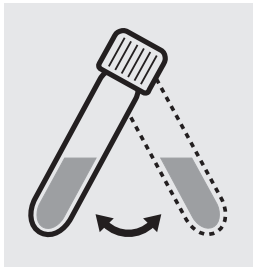
Carefully pipette 3.0 ml of the sample into a reaction cell, close tightly with the screw cap, and mix vigorously. **Caution, the cell becomes hot!**



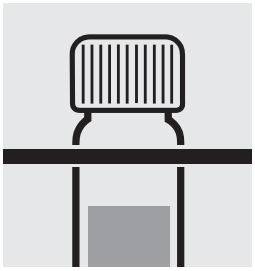
Heat the reaction cell in the thermoreactor at 148 °C for 2 hours.



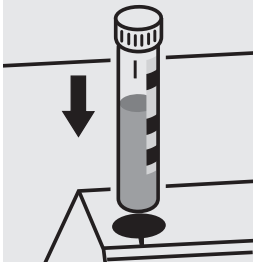
Remove the cell from the thermoreactor and place in a test-tube rack to cool.



Swirl the cell after 10 minutes.



Replace the cell in the rack for complete cooling to room temperature. **Very important!**



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) we recommended to use Spectroquant® CombiCheck 20, Cat.No. 114675, or the Standard solution for photometric applications, CRM, Cat.No. 125029, 125030, 125031, and 125032.

To check for sample-dependent effects the use of addition solutions (e.g. in CombiCheck 20) is highly recommended.

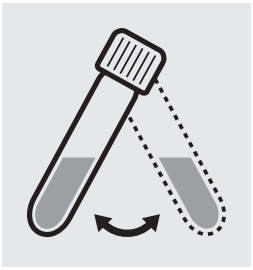
COD

Chemical Oxygen Demand

114691

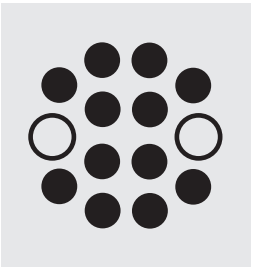
Cell Test

Measuring range:	300 – 3500 mg/l COD or O_2 Expression of results also possible in mmol/l.

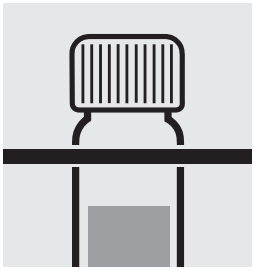


Suspend the bottom sediment in the cell by swirling.

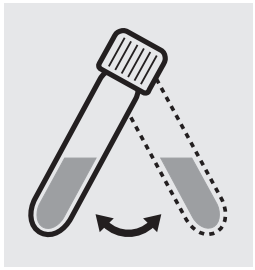
Carefully pipette 2.0 ml of the sample into a reaction cell, close tightly with the screw cap, and mix vigorously. **Caution, the cell becomes hot!**



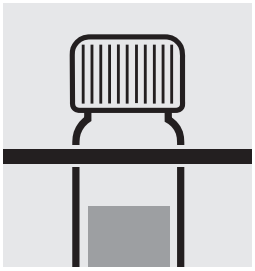
Heat the reaction cell in the thermoreactor at 148 °C for 2 hours.



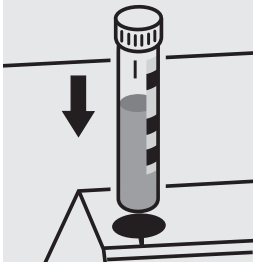
Remove the cell from the thermoreactor and place in a test-tube rack to cool.



Swirl the cell after 10 minutes.



Replace the cell in the rack for complete cooling to room temperature. **Very important!**



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

To check the measurement system (test reagents,measurement device, and handling) we recommended to use Spectroquant® CombiCheck 80, Cat.No. 114738, or the Standard solution for photometric applications, CRM, Cat.No. 125031, 125032, and 125033.

To check for sample-dependent effects the use of addition solutions (e.g. in CombiCheck 80) is highly recommended.

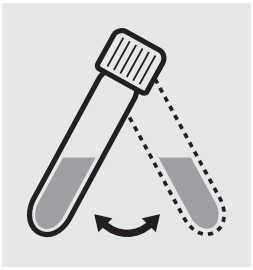
COD

Chemical Oxygen Demand

114555

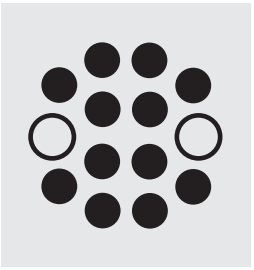
Cell Test

Measuring range:	500 – 10000 mg/l COD or O_2 Expression of results also possible in mmol/l.

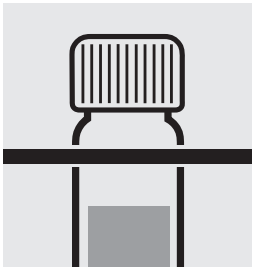


Suspend the bottom sediment in the cell by swirling.

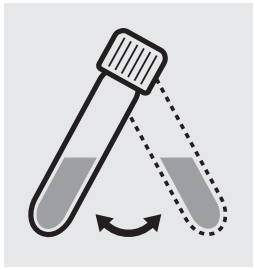
Carefully pipette 1.0 ml of the sample into a reaction cell, close tightly with the screw cap, and mix vigorously. **Caution, the cell becomes hot!**



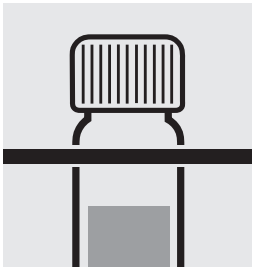
Heat the reaction cell in the thermoreactor at 148 °C for 2 hours.



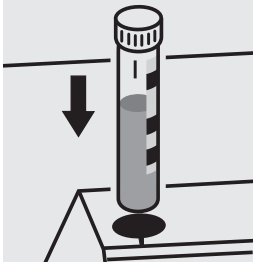
Remove the cell from the thermoreactor and place in a test-tube rack to cool.



Swirl the cell after 10 minutes.



Replace the cell in the rack for complete cooling to room temperature. **Very important!**



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) we recommended to use Spectroquant® CombiCheck 70, Cat.No. 114689, or the Standard solution for photometric applications, CRM, Cat.No. 125032, 125033, and 125034.

To check for sample-dependent effects the use of addition solutions (e.g. in CombiCheck 70) is highly recommended.

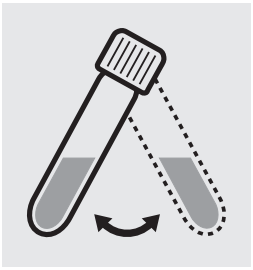
COD

Chemical Oxygen Demand

101797

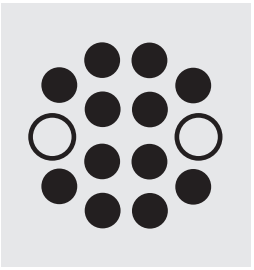
Cell Test

Measuring range:	5000–90000 mg/l COD or O_2 Expression of results also possible in mmol/l.

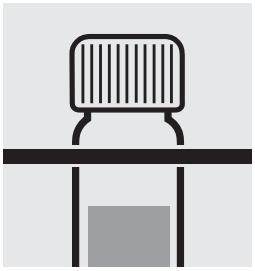


Suspend the bottom sediment in the cell by swirling.

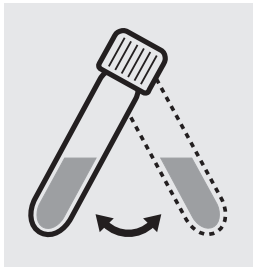
Carefully pipette 0.10 ml of the sample into a reaction cell, close tightly with the screw cap, and mix vigorously. **Caution, the cell becomes hot!**



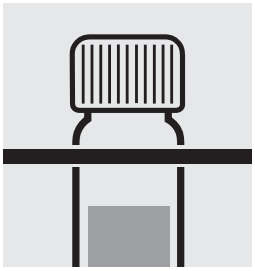
Heat the reaction cell in the thermoreactor at 148 °C for 2 hours.



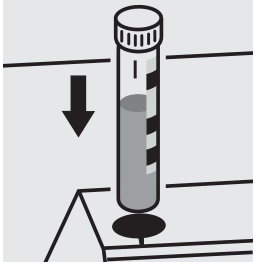
Remove the cell from the thermoreactor and place in a test-tube rack to cool.



Swirl the cell after 10 minutes.



Replace the cell in the rack for complete cooling to room temperature. **Very important!**



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) we recommended to use the Standard solution for photometric applications, CRM, Cat.No. 125034 and 125035.

COD (Hg-free)

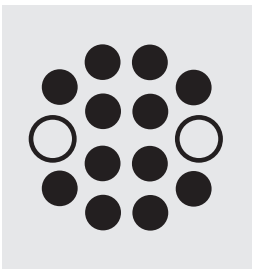
Chemical Oxygen Demand

109772

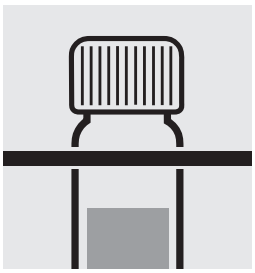
Cell Test

Measuring range:	10 – 150 mg/l COD or O_2 Expression of results also possible in mmol/l.

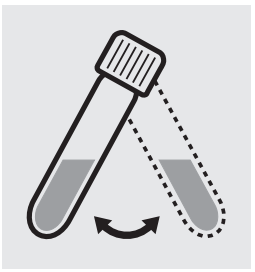
Carefully pipette 2.0 ml of the sample into a reaction cell, close tightly with the screw cap, and mix vigorously. **Caution, the cell becomes hot!**



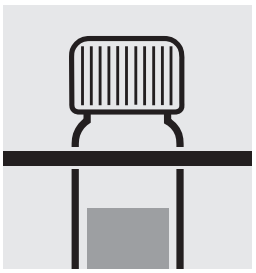
Heat the reaction cell in the thermoreactor at 148 °C for 2 hours.



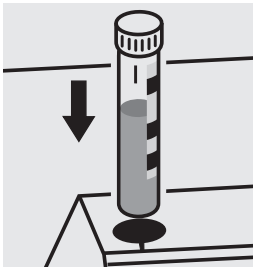
Remove the cell from the thermoreactor and place in a test-tube rack to cool.



Swirl the cell after 10 minutes.



Replace the cell in the rack for complete cooling to room temperature. **Very important!**



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) we recommended to use the Standard solution for photometric applications, CRM, Cat.No. 125028 and 125029.

COD (Hg-free)

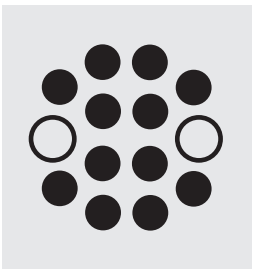
Chemical Oxygen Demand

109773

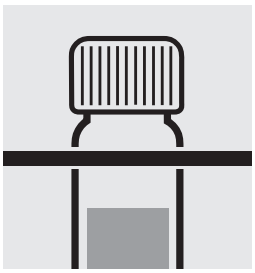
Cell Test

Measuring range:	100 – 1500 mg/l COD or O_2 Expression of results also possible in mmol/l.

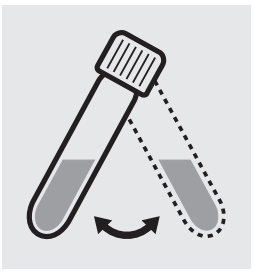
Carefully pipette 2.0 ml of the sample into a reaction cell, close tightly with the screw cap, and mix vigorously. **Caution, the cell becomes hot!**



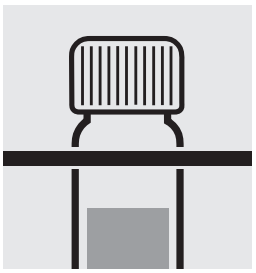
Heat the reaction cell in the thermoreactor at 148 °C for 2 hours.



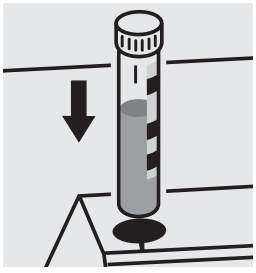
Remove the cell from the thermoreactor and place in a test-tube rack to cool.



Swirl the cell after 10 minutes.



Replace the cell in the rack for complete cooling to room temperature. **Very important!**



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) we recommended to use the Standard solution for photometric applications, CRM, Cat.No. 125029, 125030, 125031, and 125032.

COD

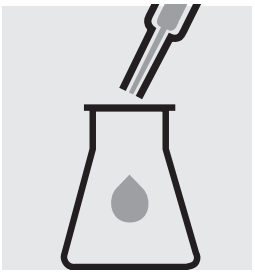
Chemical Oxygen Demand
for seawater / high chloride contents

117058

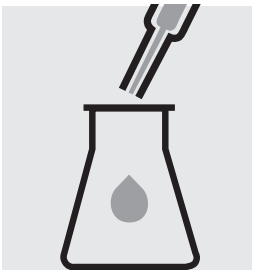
Cell Test

Measuring range: 5.0–60.0 mg/l COD or O_2 16-mm cell

Chloride depletion:

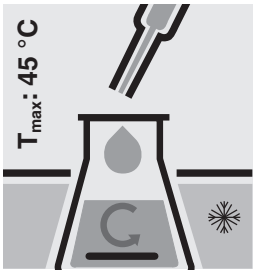


Pipette with glass pipette 20 ml of the sample into a 300-ml Erlenmeyer flask with NS 29/32.



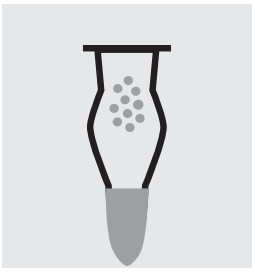
Pipette with glass pipette 20 ml of distilled water (Water for chromatography LiChrosolv®, Cat.No. 115333, is recommended) into a second 300-ml Erlenmeyer flask with NS 29/32.

Add to each a magnetic stirring rod, and cool in the ice bath.

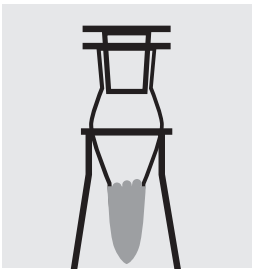


Add **slowly** to each Erlenmeyer flask 25 ml of **Sulfuric acid for the determination of COD** (Cat. No. 117048) with glass pipette **under cooling and stirring**.

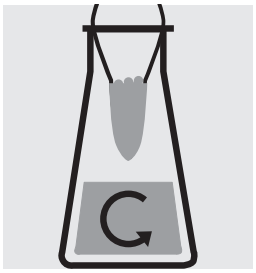
Cool both Erlenmeyer flasks to room temperature in the ice bath.



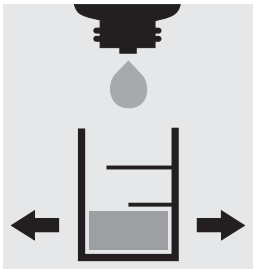
Fill 6 - 7 g each of **Sodalime with indicator** (Cat. No. 106733) into two absorption tubes (Cat. No. 115955).



Close the absorption tubes with the glass stoppers, and attach to the top of the Erlenmeyer flasks.



Stir at 250 rpm for 2 h at room temperature: depleted sample / depleted blank



Check the chloride content of the depleted sample using MColortest™ Chloride Test (Cat. No. 111132) according to the application (see the website):
Specified value
<2000 mg/l Cl^-.

Chloride determination (acc. the application instructions - abridged version):

Fill 5.0 ml of sodium hydroxide solution 2 mol/l, Cat. No. 109136, into the test vessel of the MColortest™ Chloride Test, Cat. No. 111132.
Carefully allow to run from the pipette 0.5 ml of depleted sample down the inside of the tilted test vessel onto the sodium hydroxide solution and mix (**Wear eye protection! The cell becomes hot!**).
Add 2 drops of reagent Cl-1 and swirl. The sample directly turns yellow in color. (Reagent Cl-2 is not required.)
Holding the reagent bottle vertically, slowly add reagent Cl-3 dropwise to the sample while swirling until its color changes from yellow to blue-violet. Shortly before the color changes, wait a few seconds after adding each drop.

Result in mg/l chloride = number of drops x 250

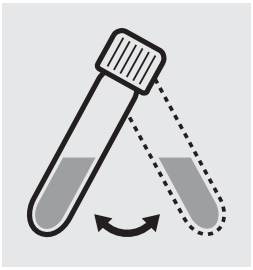
COD

Chemical Oxygen Demand
for seawater / high chloride contents

117058

Cell Test

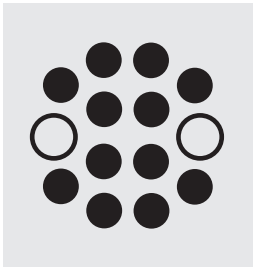
Determination:



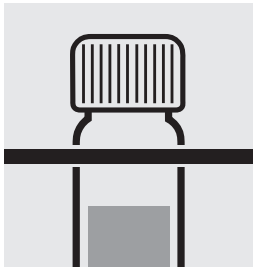
Suspend the bottom sediment in two cells by swirling.

Carefully pipette 5.0 ml of the **depleted sample** into a reaction cell, close tightly with the screw cap, and mix vigorously.
Caution, the cell becomes hot!

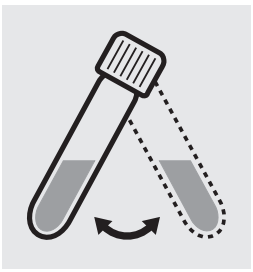
Carefully pipette 5.0 ml of the **depleted blank** into a second reaction cell, close tightly with the screw cap, and mix vigorously.
Caution, the cell becomes hot!
(Blank cell)



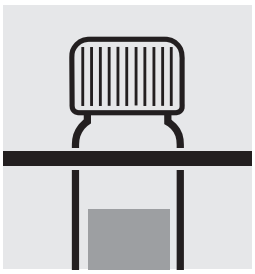
Heat both cells in the thermoreactor at 148 °C for 2 hours.



Remove both cells from the thermoreactor and place in a test-tube rack to cool.

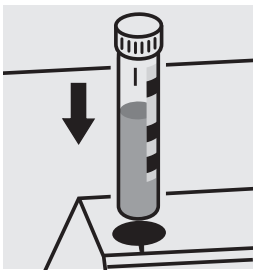


Swirl both cells after 10 minutes.

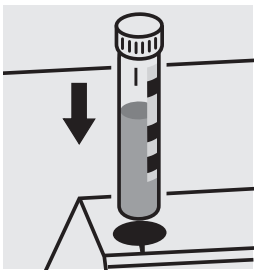


Replace both cells in the rack for complete cooling to room temperature. (**Very important!**)

Configure the photometer for blank-measurement.



Place the blank cell into the cell compartment. Align the mark on the cell with that on the photometer.



Place the cell containing the sample into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) a COD/chloride standard solution must be prepared from Potassium hydrogen phthalate, Cat.No. 102400 and Sodium chloride, Cat.No. 106404 (see section “Standard solutions”).

COD

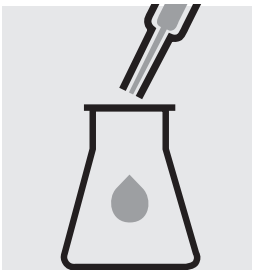
Chemical Oxygen Demand
for seawater / high chloride contents

117059

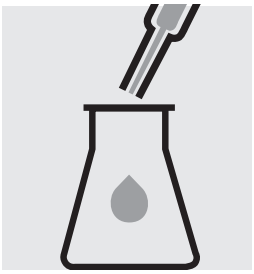
Cell Test

Measuring range: 50–3000 mg/l COD or O_2 16-mm cell

Chloride depletion:

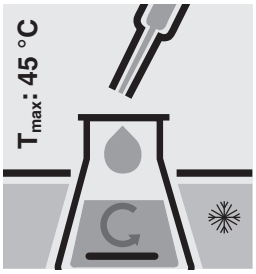


Pipette with glass pipette 20 ml of the sample into a 300-ml Erlenmeyer flask with NS 29/32.



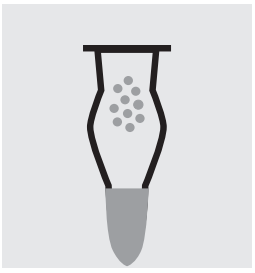
Pipette with glass pipette 20 ml of distilled water (Water for chromatography LiChrosolv®, Cat.No. 115333, is recommended) into a second 300-ml Erlenmeyer flask with NS 29/32.

Add to each a magnetic stirring rod, and cool in the ice bath.

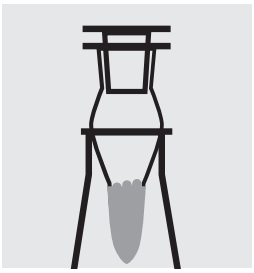


Add **slowly** to each Erlenmeyer flask 25 ml of **Sulfuric acid for the determination of COD** (Cat. No. 117048) with glass pipette **under cooling and stirring**.

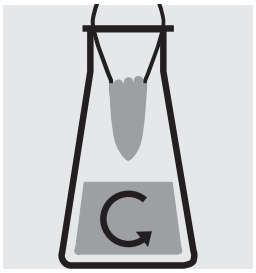
Cool both Erlenmeyer flasks to room temperature in the ice bath.



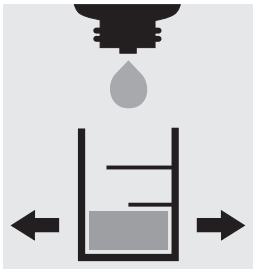
Fill 6 - 7 g each of **Sodalime with indicator** (Cat. No. 106733) into two absorption tubes (Cat. No. 115955).



Close the absorption tubes with the glass stoppers, and attach to the top of the Erlenmeyer flasks.



Stir at 250 rpm for 2 h at room temperature: depleted sample / depleted blank



Check the chloride content of the depleted sample using MColortest™ Chloride Test (Cat. No. 111132) according to the application (see the website):
specified value <250 mg/l Cl^-.

Chloride determination (acc. the application instructions - abridged version):

Fill 5.0 ml of sodium hydroxide solution 2 mol/l, Cat. No. 109136, into the test vessel of the MColortest™ Chloride Test, Cat. No. 111132.
Carefully allow to run from the pipette 0.5 ml of depleted sample down the inside of the tilted test vessel onto the sodium hydroxide solution and mix (**Wear eye protection! The cell becomes hot!**).
Add 2 drops of reagent Cl-1 and swirl. The sample directly turns yellow in color. (Reagent Cl-2 is not required.)
Holding the reagent bottle vertically, slowly add reagent Cl-3 dropwise to the sample while swirling until its color changes from yellow to blue-violet. Shortly before the color changes, wait a few seconds after adding each drop.

Result in mg/l chloride = number of drops x 250

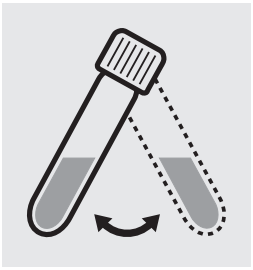
COD

Chemical Oxygen Demand
for seawater / high chloride contents

117059

Cell Test

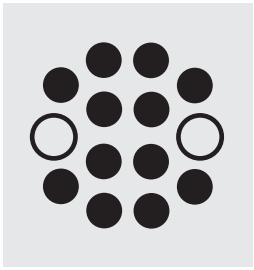
Determination:



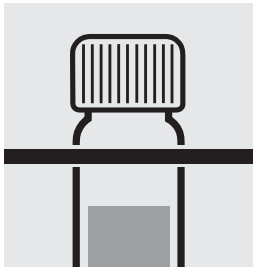
Suspend the bottom sediment in two cells by swirling.

Carefully pipette 3.0 ml of the **depleted sample** into a reaction cell, close tightly with the screw cap, and mix vigorously.
Caution, the cell becomes hot!

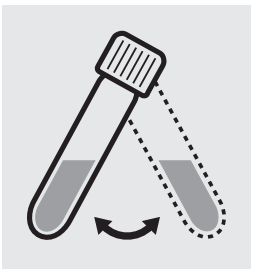
Carefully pipette 3.0 ml of the **depleted blank** into a second reaction cell, close tightly with the screw cap, and mix vigorously.
Caution, the cell becomes hot!
(Blank cell)



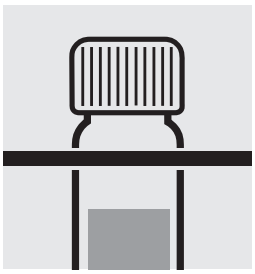
Heat both cells in the thermoreactor at 148 °C for 2 hours.



Remove both cells from the thermoreactor and place in a test-tube rack to cool.

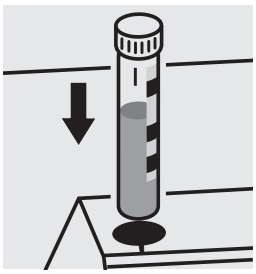


Swirl both cells after 10 minutes.

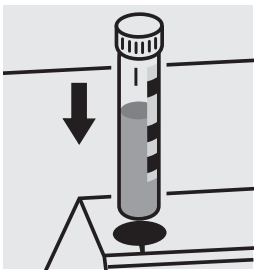


Replace both cells in the rack for complete cooling to room temperature. (**Very important!**)

Configure the photometer for blank-measurement.



Place the blank cell into the cell compartment. Align the mark on the cell with that on the photometer.



Place the cell containing the sample into the cell compartment. Align the mark on the cell with that on the photometer.

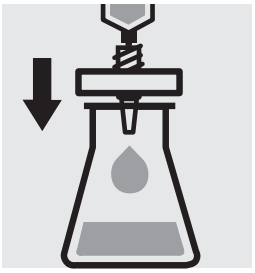
Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) a COD/chloride standard solution must be prepared from Potassium hydrogen phthalate, Cat.No. 102400 and Sodium chloride, Cat.No. 106404 (see section “Standard solutions”).

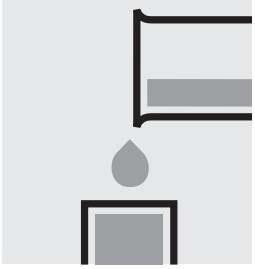
Color
(Spectral Absorption Coefficient)

analogous to **EN ISO 7887**

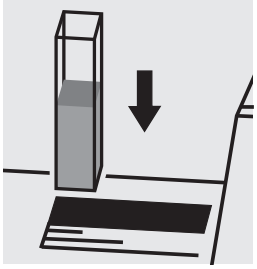
Measuring	1 – 250 m^{-1}	436 nm	10-mm cell	Method No. 015 α(436)
range:	0.3 – 125.0 m^{-1}	436 nm	20-mm cell	Method No. 015 α(436)
	0.1 – 50.0 m^{-1}	436 nm	50-mm cell	Method No. 015 α(436)
	1 – 250 m^{-1}	525 nm	10-mm cell	Method No. 061 α(525)
	0.3 – 125.0 m^{-1}	525 nm	20-mm cell	Method No. 061 α(525)
	0.1 – 50.0 m^{-1}	525 nm	50-mm cell	Method No. 061 α(525)
	1 – 250 m^{-1}	620 nm	10-mm cell	Method No. 078 α(620)
	0.3 – 125.0 m^{-1}	620 nm	20-mm cell	Method No. 078 α(620)
	0.1 – 50.0 m^{-1}	620 nm	50-mm cell	Method No. 078 α(620)



Filter sample solution through a membrane filter with 0.45 µm pore size.



Transfer the solution into a corresponding cell.



Place the cell into the cell compartment, select method no. **15**, **61**, or **78**.

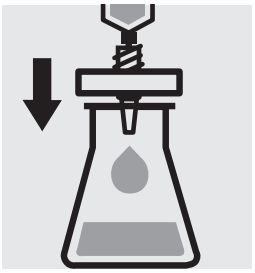
Notes:
Filtered sample = true color.
Unfiltered sample = apparent color.

Color

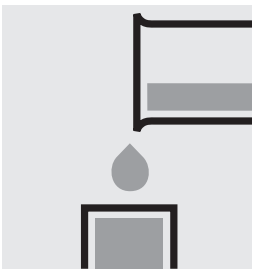
(True Color - 410 nm)

analogous to **EN ISO 7887**

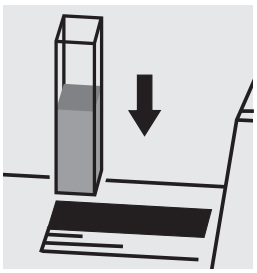
Measuring	10 – 2500	mg/l Pt	10 – 2500	mg/l Pt/Co	10 – 2500	CU	10-mm cell
range:	5 – 1250	mg/l Pt	5 – 1250	mg/l Pt/Co	5 – 1250	CU	20-mm cell
	2 – 500	mg/l Pt	2 – 500	mg/l Pt/Co	2 – 500	CU	50-mm cell



Filter sample solution through a membrane filter with 0.45 µm pore size.



Transfer the solution into a corresponding cell.

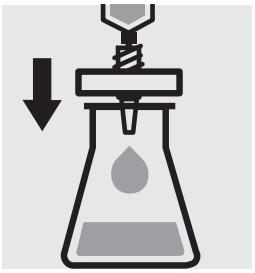


Place the cell into the cell compartment, select method no. **303**.

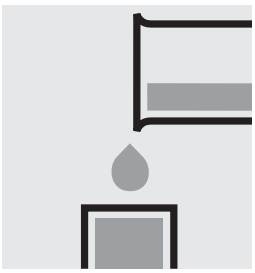
Color Hazen
(Platinum-Cobalt Standard Method)

analogous to **APHA 2120B, DIN EN ISO 6271-2, Water Research Vol. 30, No. 11, 2771-2775, 11996**

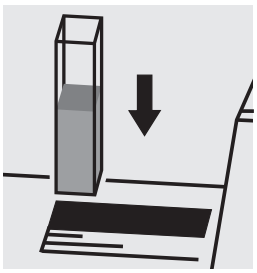
Measuring	1	- 500 mg/l Pt/Co	1	- 500 mg/l Pt	1	- 500 Hazen	1	- 500 CU	340 nm	10-mm cell
range:	1	- 250 mg/l Pt/Co	1	- 250 mg/l Pt	1	- 250 Hazen	1	- 250 CU	340 nm	20-mm cell
	0.2	- 100.0 mg/l Pt/Co	0.2	- 100.0 mg/l Pt	0.2	- 100.0 Hazen	0.2	- 100.0 CU	340 nm	50-mm cell



Filter sample solution through a membrane filter with 0.45 µm pore size.



Transfer the solution into a corresponding cell.



Place the cell into the cell compartment, select method no. **32**.

Notes:
Filtered sample = true color.
Unfiltered sample = apparent color.

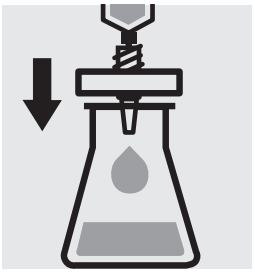
Quality assurance:

To check the measurement system (measurement device, handling) ready-for-use Platinum Cobalt Color Reference Solution (Hazen 500) Certipur®, Cat.No. 100246, concentration 500 mg/l Pt, can be used after diluting accordingly.

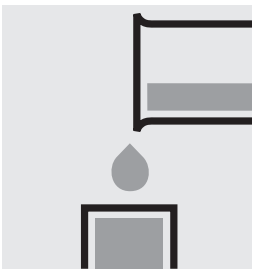
Color Hazen
(Platinum-Cobalt Standard Method)

analogous to **APHA 2120B, DIN EN ISO 6271-2, Water Research Vol. 30, No. 11, 2771-2775, 11996**

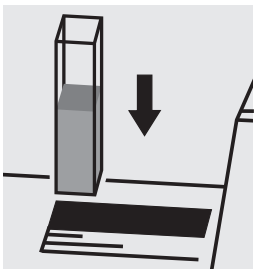
Measuring	1-1000 mg/l Pt/Co	1-1000 mg/l Pt	1-1000 Hazen	1-1000 CU	445 nm	50-mm cell	Method No. 179
range:	1-1000 mg/l Pt/Co	1-1000 mg/l Pt	1-1000 Hazen	1-1000 CU	455 nm	50-mm cell	Method No. 180
	1-1000 mg/l Pt/Co	1-1000 mg/l Pt	1-1000 Hazen	1-1000 CU	465 nm	50-mm cell	Method No. 181



Filter sample solution through a membrane filter with 0.45 µm pore size.



Transfer the solution into the cell.



Place the cell into the cell compartment, select method no. **179, 180**, or **181**.

Notes:
Filtered sample = true color.
Unfiltered sample = apparent color.

Quality assurance:

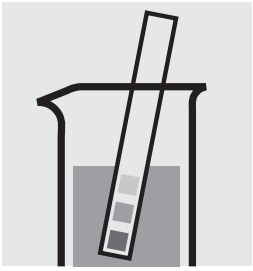
To check the measurement system (measurement device, handling) ready-for-use Platinum Cobalt Color Reference Solution (Hazen 500) Certipur®, Cat.No. 100246, concentration 500 mg/l Pt, can be used.

Copper

114553

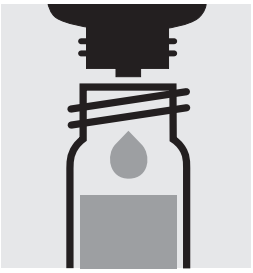
Cell Test

Measuring range:	0.05 – 8.00 mg/l Cu Expression of results also possible in mmol/l.



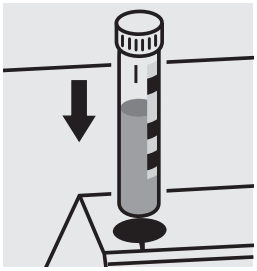
Check the pH of the sample, specified range: pH 4 – 10.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.

Pipette 5.0 ml of the sample into a reaction cell, close with the screw cap, and mix.



Add 5 drops of **Cu-1K**, close the cell with the screw cap, and mix.

Reaction time: 5 minutes



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Important:

Very high copper concentrations in the sample produce turquoise-colored solutions (measurement solution should be blue) and false-low readings are yielded.
In such cases the sample must be diluted (plausibility check).

For the determination of **total copper** a pretreatment with Crack Set 10C, Cat.No. 114688, or Crack Set 10, Cat.No. 114687 and thermoreactor is necessary.

Result can be expressed as sum of copper (Σ Cu).

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) we recommended to use Spectroquant® CombiCheck 30, Cat.No. 114677.

Ready-for-use copper standard solution Certipur®, Cat.No. 119786, concentration 1000 mg/l Cu, can also be used after diluting accordingly.

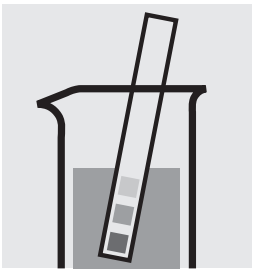
To check for sample-dependent effects the use of addition solutions (e.g. in CombiCheck 30) is highly recommended.

Copper

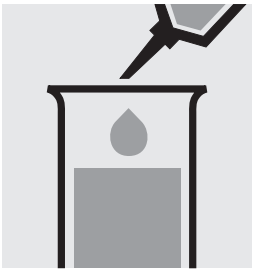
114767

Test

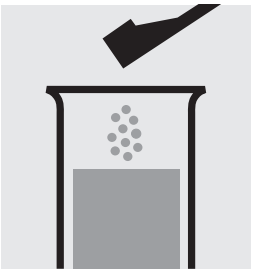
Measuring	0.10 – 6.00 mg/l Cu	10-mm cell
range:	0.05 – 3.00 mg/l Cu	20-mm cell
	0.02 – 1.20 mg/l Cu	50-mm cell
	Expression of results also possible in mmol/l.	



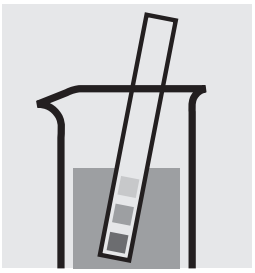
Check the pH of the sample, specified range: pH 4 – 10.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.



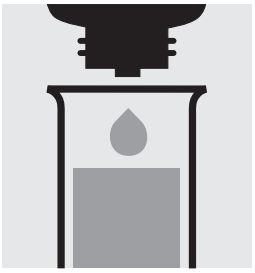
Pipette 5.0 ml of the sample into a test tube.



Add 1 green dosing spoon of **Cu-1** and dissolve the solid substance.

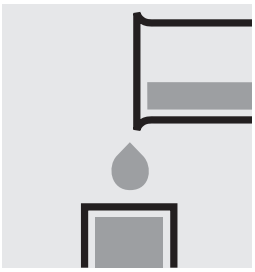


Check the pH, specified range: pH 7.0 – 9.5.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.

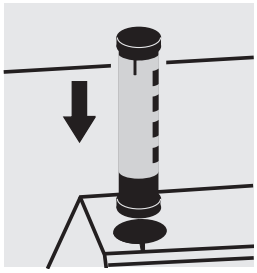


Add 5 drops of **Cu-2** and mix.

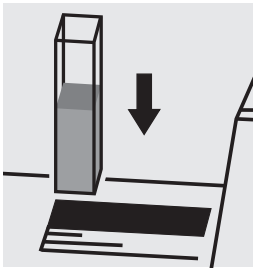
Reaction time:
5 minutes



Transfer the solution into a corresponding cell.



Select method with AutoSelector.



Place the cell into the cell compartment.

Important:

Very high copper concentrations in the sample produce turquoise-colored solutions (measurement solution should be blue) and false-low readings are yielded.
In such cases the sample must be diluted (plausibility check).

For the determination of **total copper** a pretreatment with Crack Set 10C, Cat.No. 114688, or Crack Set 10, Cat.No. 114687 and thermoreactor is necessary.

Result can be expressed as sum of copper (Σ Cu).

To measure in the 50-mm cell, only the sample volume has to be doubled.
Alternatively, the semi-microcell, Cat.No. 173502, can be used.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) we recommended to use Spectroquant® CombiCheck 30, Cat.No. 114677.

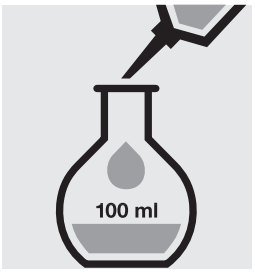
Ready-for-use copper standard solution Certipur®, Cat.No. 119786, concentration 1000 mg/l Cu, can also be used after diluting accordingly.

To check for sample-dependent effects the use of addition solutions (e.g. in CombiCheck 30) is highly recommended.

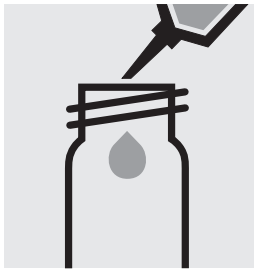
Copper in electroplating baths

Inherent color

Measuring	10.0 – 80.0 g/l Cu	10-mm cell
range:	5.0 – 40.0 g/l Cu	20-mm cell
	2.0 – 16.0 g/l Cu	50-mm cell

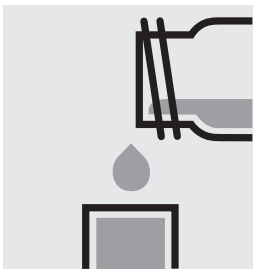


Pipette 25 ml of the sample into a 100-ml volumetric flask, fill to the mark with distilled water and mix thoroughly.

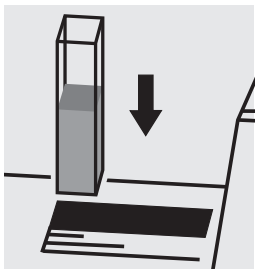


Pipette 5.0 ml of the 1:4 dilute sample into an empty round cell (Empty cells, Cat.No. 114724).

Add 5.0 ml of **sulfuric acid 40 %**, close the cell with the screw cap, and mix.



Transfer the solution into a corresponding rectangular cell.



Place the cell into the cell compartment. Select method no. **83**.

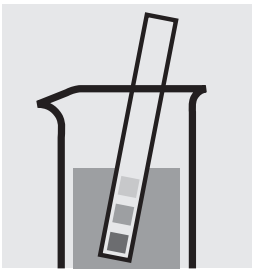
Cyanide

Determination of free cyanide

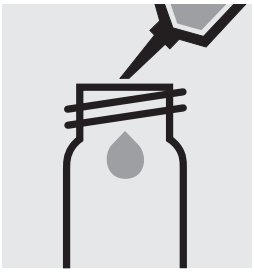
102531

Cell Test

Measuring range:	0.010 – 0.500 mg/l CN Expression of results also possible in mmol/l and cyanide free [CN(f)].

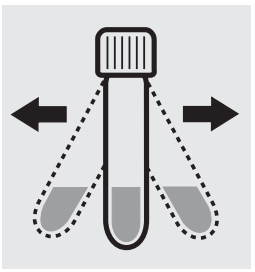


Check the pH of the sample, specified range: pH 4.5 – 8.0.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.



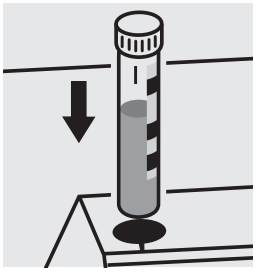
Pipette 5.0 ml of the sample into a reaction cell, close with the screw cap, and dissolve the solid substance.

Add 1 level blue micro-spoon of **CN-1K**, close the cell with the screw cap.



Shake the cell vigorously to dissolve the solid substance.

Reaction time: 10 minutes



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) ready-for-use cyanide standard solution Certipur®, Cat.No. 119533, concentration 1000 mg/l CN^-, can be used after diluting accordingly.

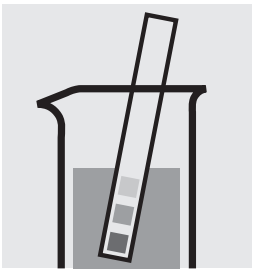
Cyanide

Determination of free cyanide

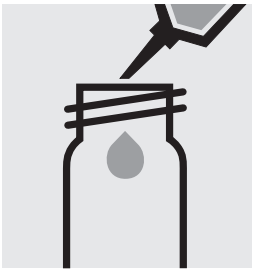
114561

Cell Test

Measuring range:	0.010 – 0.500 mg/l CN Expression of results also possible in mmol/l and cyanide free [CN(f)].

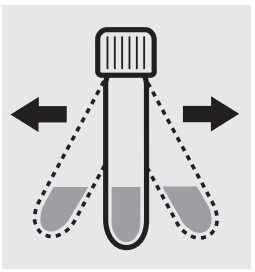


Check the pH of the sample, specified range: pH 4.5 – 8.0.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.



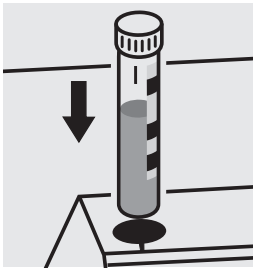
Pipette 5.0 ml of the sample into a reaction cell, close with the screw cap, and dissolve the solid substance.

Add 1 level blue micro-spoon of **CN-3K**, close the cell with the screw cap.



Shake the cell vigorously to dissolve the solid substance.

Reaction time: 10 minutes



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) ready-for-use cyanide standard solution Certipur®, Cat.No. 119533, concentration 1000 mg/l CN^-, can be used after diluting accordingly.

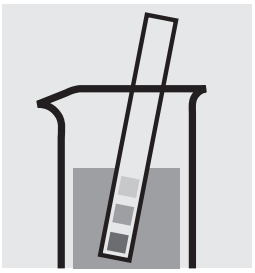
Cyanide

Determination of readily liberated cyanide

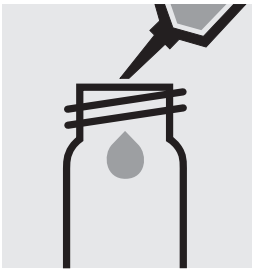
114561

Cell Test

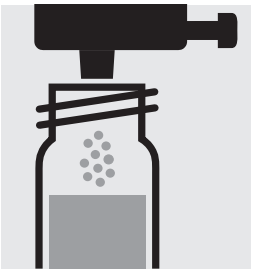
Measuring range:	0.010 – 0.500 mg/l CN Expression of results also possible in mmol/l and cyanide readily liberated [CN(v)].



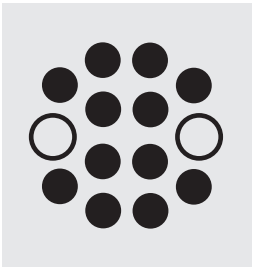
Check the pH of the sample, specified range: pH 4.5 – 8.0.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.



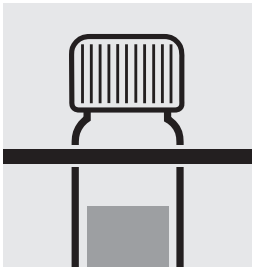
Pipette 10 ml of the sample into an empty round cell (Empty cells, Cat.No. 114724).



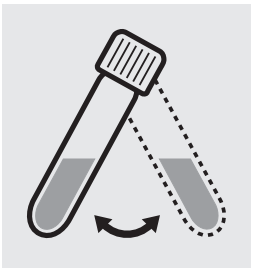
Add 1 dose of **CN-1K** using the green dose-metering cap, close the cell with the screw cap.



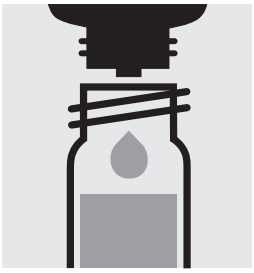
Heat the cell in the thermoreactor at 120 °C (100 °C) for 30 minutes.



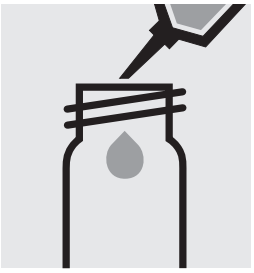
Remove the cell from the thermoreactor and place in a test-tube rack to cool to room temperature.



Swirl the cell before opening.

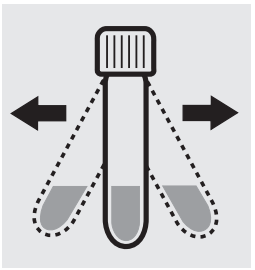


Add 3 drops of **CN-2K**, close with the screw cap, and mix: **pretreated sample**.



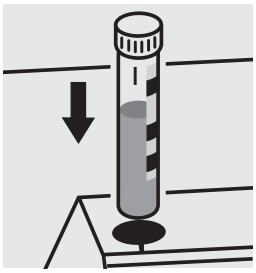
Pipette 5.0 ml of the **pretreated sample** into a reaction cell, close with the screw cap, and dissolve the solid substance.

Add 1 level blue microspoon of **CN-3K**, close the cell with the screw cap.



Shake the cell vigorously to dissolve the solid substance.

Reaction time:
10 minutes



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) ready-for-use cyanide standard solution Certipur®, Cat.No. 119533, concentration 1000 mg/l CN^-, can be used after diluting accordingly.

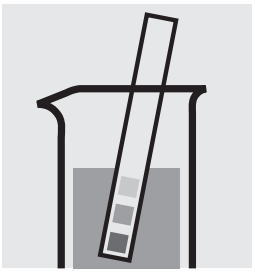
Cyanide

Determination of free cyanide

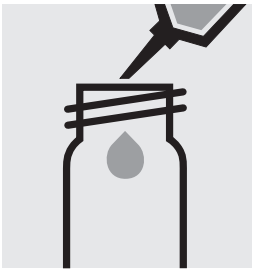
109701

Test

Measuring range:	0.010 – 0.500 mg/l CN	10-mm cell
	0.005 – 0.250 mg/l CN	20-mm cell
	0.0020 – 0.1000 mg/l CN	50-mm cell
	Expression of results also possible in mmol/l and cyanide free [CN(f)].	

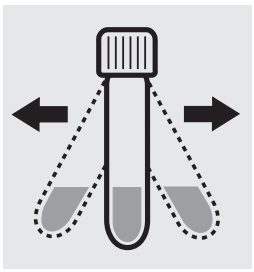


Check the pH of the sample, specified range: pH 4.5 – 8.0.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.



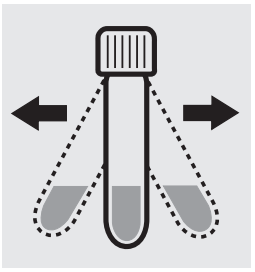
Pipette 5.0 ml of the sample into an empty round cell (Empty cells, Cat.No. 114724).

Add 1 level green micro-spoon of **CN-3,** close the cell with the screw cap.



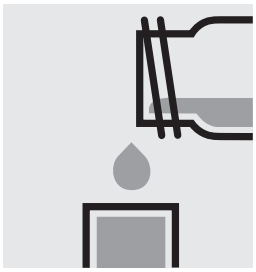
Shake the cell vigorously to dissolve the solid substance.

Add 1 level blue micro-spoon of **CN-4,** close the cell with the screw cap.

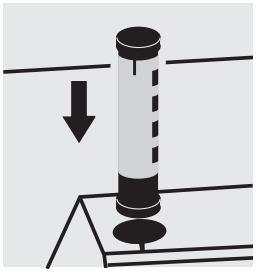


Shake the cell vigorously to dissolve the solid substance.

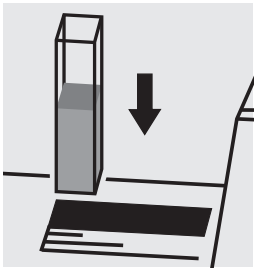
Reaction time:
10 minutes



Transfer the solution into a corresponding rectangular cell.



Select method with AutoSelector.



Place the cell into the cell compartment.

Note:

Empty cells with screw caps, Cat.No. 114724 are recommended for the preparation. These cells can be sealed with the screw caps, thus preventing any gas losses.

Important:

To measure in the 50-mm cell, the sample volume and the volume of the reagents CN-3 and CN-4 have to be doubled for each.
Alternatively, the semi-microcell, Cat.No. 173502, can be used.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) ready-for-use cyanide standard solution Certipur®, Cat.No. 119533, concentration 1000 mg/l CN^-, can be used after diluting accordingly.

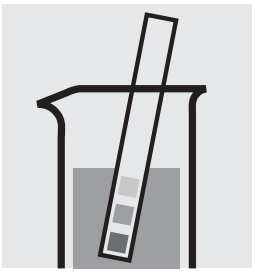
Cyanide

Determination of readily liberated cyanide

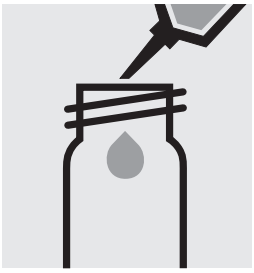
109701

Test

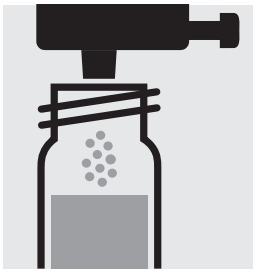
Measuring	0.010 – 0.500 mg/l CN	10-mm cell
range:	0.005 – 0.250 mg/l CN	20-mm cell
	0.0020 – 0.1000 mg/l CN	50-mm cell
	Expression of results also possible in mmol/l and cyanide readily liberated [CN(v)].	



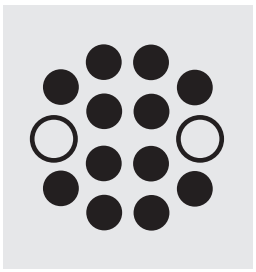
Check the pH of the sample, specified range: pH 4.5 – 8.0.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.



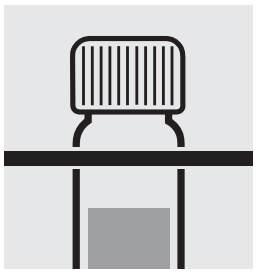
Add 10 ml of the sample into an empty round cell (Empty cells, Cat.No. 114724).



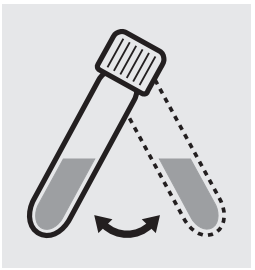
Add 1 dose of **CN-1** using the green dose-metering cap, close the cell with the screw cap.



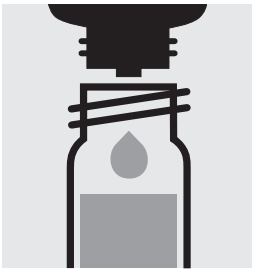
Heat the cell in the thermoreactor at 120 °C (100 °C) for 30 minutes.



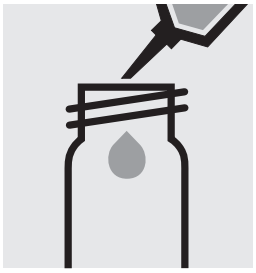
Remove the cell from the thermoreactor and place in a test-tube rack to cool to room temperature.



Swirl the cell before opening.

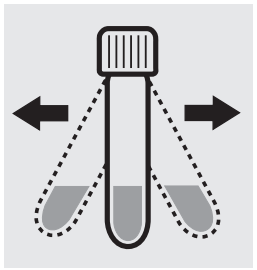


Add 3 drops of **CN-2**, close with the scew cap, and mix: **pretreated sample**.



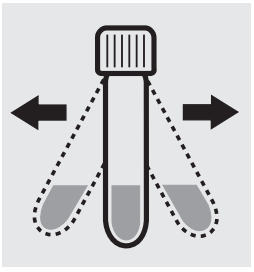
Pipette 5.0 ml of the **pretreated sample** into an empty round cell (Empty cells, Cat.No. 114724).

Add 1 level green micro-spoon of **CN-3**, close the cell with the screw cap.



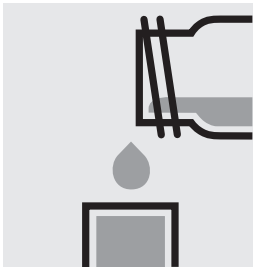
Shake the cell vigorously to dissolve the solid substance.

Add 1 level blue micro-spoon of **CN-4**, close the cell with the screw cap.

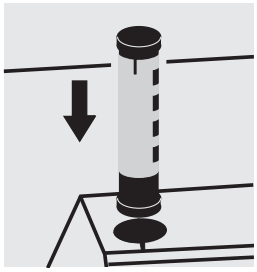


Shake the cell vigorously to dissolve the solid substance.

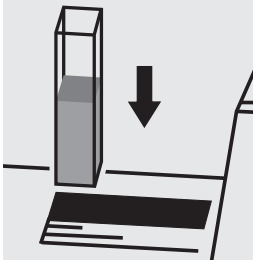
Reaction time:
10 minutes



Transfer the solution into a corresponding rectangular cell.



Select method with AutoSelector.



Place the cell into the cell compartment.

Note:

Empty cells with screw caps, Cat.No. 114724 are recommended for the preparation. These cells can be sealed with the screw caps, thus preventing any gas losses.

Important:

To measure in the 50-mm cell, the sample volume and the volume of the reagents CN-3 and CN-4 have to be doubled for each.
Alternatively, the semi-microcell, Cat.No. 173502, can be used.

Quality assurance:

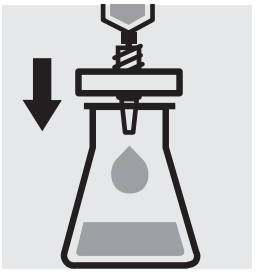
To check the measurement system (test reagents, measurement device, and handling) ready-for-use cyanide standard solution Certipur®, Cat.No. 119533, concentration 1000 mg/l CN^-, can be used after diluting accordingly.

Cyanuric Acid

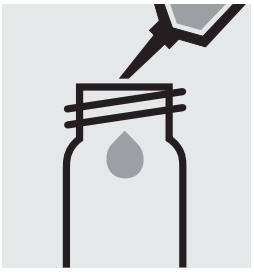
119253

Test

Measuring range:	2 – 160 mg/l cyanuric acid Expression of results also possible in mmol/l.	20-mm cell



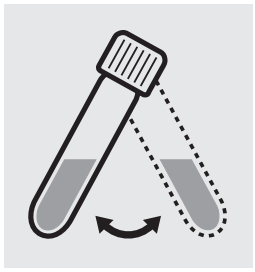
Filter turbid samples.



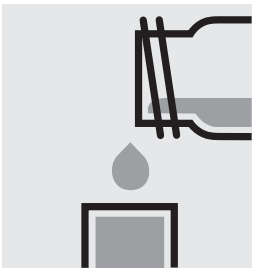
Pipette 5.0 ml of the sample into into an empty test tube (e. g. flat-bottomed tubes cells, Cat.No. 114902).

Add **5.0 ml of distilled water** (Water for analysis EMSURE®, Cat.No. 116754, is recommended) with pipette, close with the screw cap, and mix.

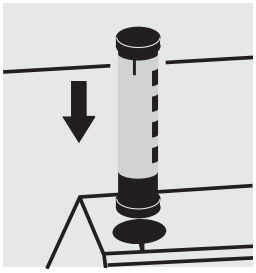
Add 1 **reagent tablet Cyanuric Acid**, crush with stirring rod, and close with the screw cap.



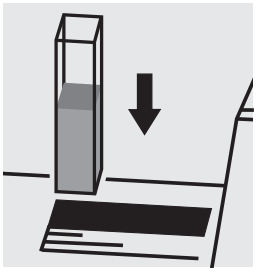
Swirl the cell to dissolve the solid substance.



Transfer the solution into a rectangular cell.



Select method with AutoSelector.



Place the cell into the cell compartment.

Quality assurance:

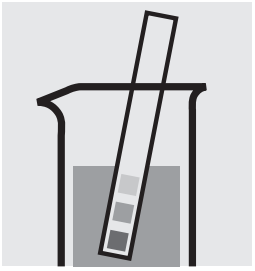
To check the measurement system (test reagents, measurement device, and handling) a cyanuric acid standard solution must be prepared from Cyanuric acid, Cat.No. 820358 (see section “Standard solutions”).

Fluoride

114557

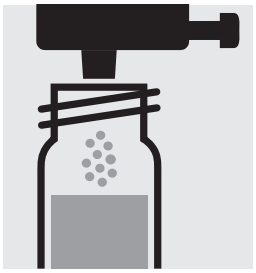
Cell Test

Measuring	0.10 – 1.50 mg/l F	Round cell
range:	0.025 – 0.500 mg/l F	50-mm cell (see “sensitive” preparation procedure)
	Expression of results also possible in mmol/l.	

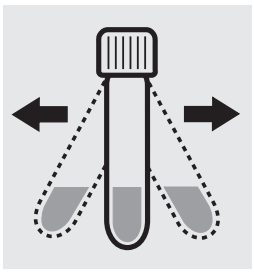


Check the pH of the sample, specified range: pH 3 – 8.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.

Pipette 5.0 ml of the sample into a reaction cell, close with the screw cap, and mix.

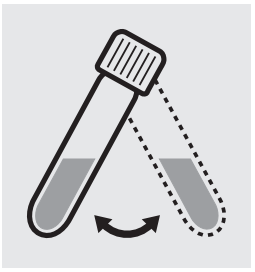


Add 1 dose of **F-1K** using the blue dose-metering cap, close the cell with the screw cap.

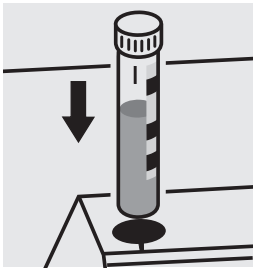


Shake the cell vigorously to dissolve the solid substance.

Reaction time: 5 minutes



Swirl the cell before measurement.



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Fluoride sensitive

Use the same preparation procedure as above, but add 10 ml of sample instead of 5.0 ml. Prepare an own blank by using 10 ml of distilled water and all reagents. For measurement transfer the solution into a 50-mm cell. Select method **F sens** in the menu (method no. 124).

Important:

Very high fluoride concentrations in the sample produce brown-colored solutions (measurement solution should be violet) and false-low readings are yielded. In such cases the sample must be diluted (plausibility check).

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) ready-for-use fluoride standard solution Certipur®, Cat.No. 119814, concentration 1000 mg/l F^-, can be used after diluting accordingly.

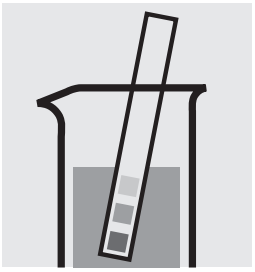
Fluoride

100809

Cell Test

Measuring	0.10 – 1.80 mg/l F	Round cell
range:	0.025 – 0.500 mg/l F	50-mm cell
	Expression of results also possible in mmol/l.	

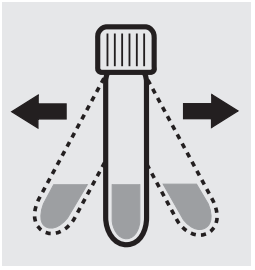
Measuring range: 0.10 – 1.80 mg/l F



Check the pH of the sample, specified range: pH 3 – 8.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.

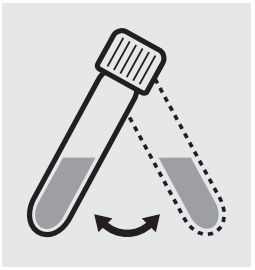
Pipette 5.0 ml of the sample into a reaction cell, close with the screw cap, and mix.

Add 1 level blue micro-spoon of **F-1K**, close the cell with the screw cap.

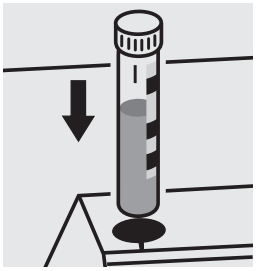


Shake the cell vigorously to dissolve the solid substance.

Reaction time: 15 minutes



Swirl the cell before measurement.



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Fluoride sensitive

Use the same preparation procedure as above, but add 10 ml of sample instead of 5.0 ml. Prepare an own blank by using 10 ml of distilled water and all reagents. For measurement transfer the solution into a 50-mm cell. Configure the photometer prior for blank-measurement. Select method **F sens** in the menu (method no. 216).

Important:

Very high fluoride concentrations in the sample produce brown-colored solutions (measurement solution should be violet) and false-low readings are yielded. In such cases the sample must be diluted (plausibility check).

Quality assurance:

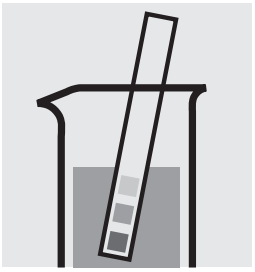
To check the measurement system (test reagents, measurement device, and handling) ready-for-use fluoride standard solution Certipur®, Cat.No. 119814, concentration 1000 mg/l F^-, can be used after diluting accordingly.

Fluoride

100809

Cell Test

Measuring range: 0.025 – 0.500 mg/l F



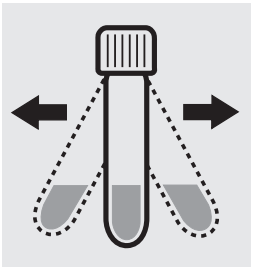
Check the pH of the sample, specified range: pH 3 – 8.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.

Select method **F sens** in the menu (method no. 216).

Pipette 10 ml of the sample into a reaction cell, close with the screw cap, and mix.

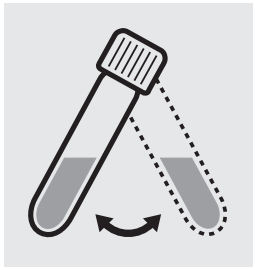
Pipette 10 ml of distilled water into a second reaction cell, close with the screw cap, and mix. (Blank)

Add 1 level blue microspoon of **F-1K** to each cell, close with the screw cap.

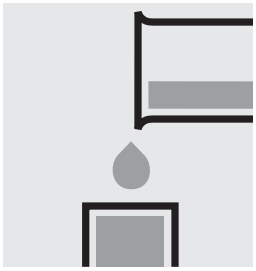


Shake both cells vigorously to dissolve the solid substance.

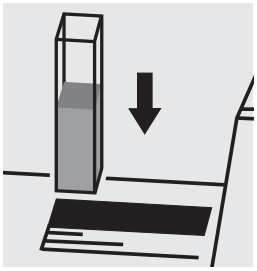
Reaction time:
15 minutes



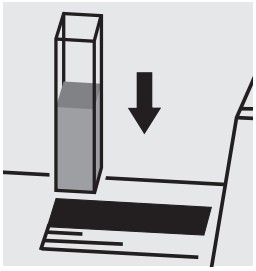
Swirl the cells.



Transfer both solutions into two separate 50-mm-cells.



Place the blank cell into the cell compartment.



Place the cell containing the sample into the cell compartment.

Important:

Very high fluoride concentrations in the sample produce brown-colored solutions (measurement solution should be violet) and false-low readings are yielded. In such cases the sample must be diluted (plausibility check).

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) ready-for-use fluoride standard solution Certipur®, Cat.No. 119814, concentration 1000 mg/l F^-, can be used after diluting accordingly.

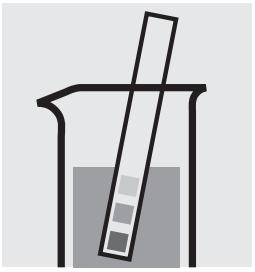
Fluoride

114598

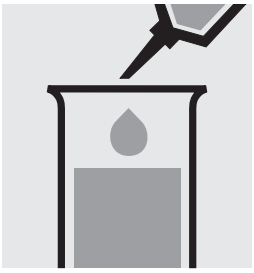
Test

Measuring range:	0.10 – 2.00 mg/l F	10-mm cell
	1.0 – 20.0 mg/l F	10-mm cell
	Expression of results also possible in mmol/l.	

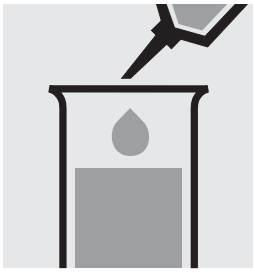
Measuring range: 0.10 – 2.00 mg/l F



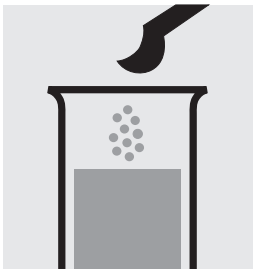
Check the pH of the sample, specified range: pH 3 – 8.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.



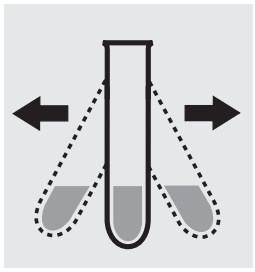
Pipette 2.0 ml of **F-1** into a test tube.



Add 5.0 ml of the sample with pipette and mix.

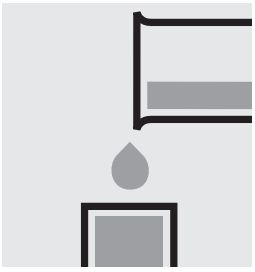


Add 1 level blue microspoon of **F-2** and mix.

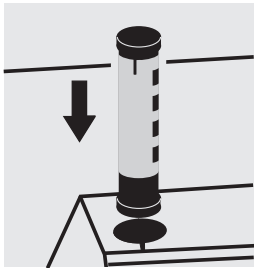


Shake the test tube vigorously to dissolve the solid substance.

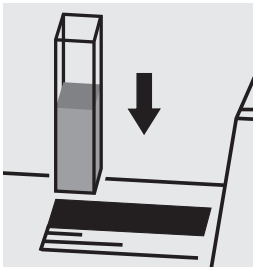
Reaction time:
5 minutes



Transfer the solution into a cell.

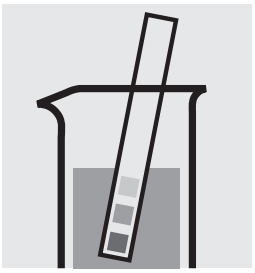


Select method with AutoSelector measuring range 0.10 – 2.00 mg/l F.

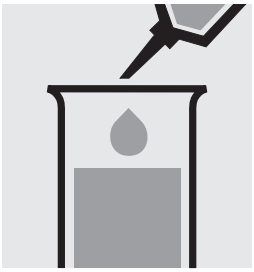


Place the cell into the cell compartment.

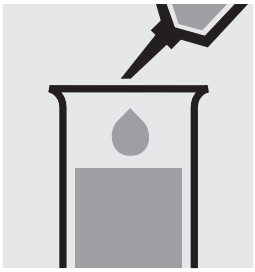
Measuring range: 1.0 – 20.0 mg/l F



Check the pH of the sample, specified range: pH 3 – 8.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.



Pipette 2.0 ml of **F-1** into a test tube.



Add 5.0 ml of water and 0.5 ml of the sample with pipette and mix.

Continue as mentioned above; starting from the addition of **F-2** (Fig. 4). Select method with AutoSelector measuring range 1.0 – 20.0 mg/l F.

Important:

Very high fluoride concentrations in the sample produce brown-colored solutions (measurement solution should be violet) and false-low readings are yielded. In such cases the sample must be diluted (plausibility check).

Quality assurance:

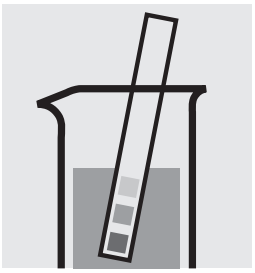
To check the measurement system (test reagents, measurement device, and handling) ready-for-use fluoride standard solution Certipur®, Cat.No. 119814, concentration 1000 mg/l F^-, can be used after diluting accordingly.

Fluoride

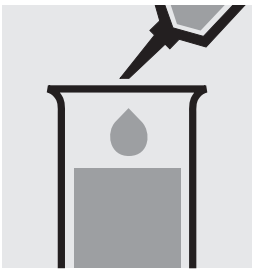
100822

Test

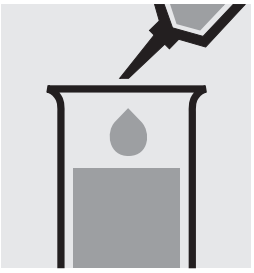
Measuring range:	0.02 – 2.00 mg/l F	50-mm semi-microcell, Cat. No. 173502
	Expression of results also possible in mmol/l.	



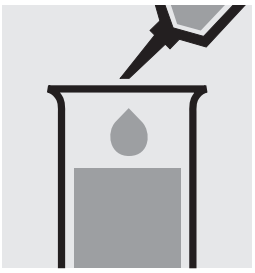
Check the pH of the sample, specified range: pH 1 – 10.
If required, add dilute sodium hydroxide solution or hydrochloric acid drop by drop to adjust the pH.



Pipette 5.0 ml of the sample into a test tube.

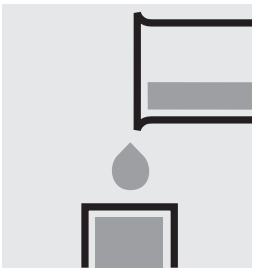


Pipette 5.0 ml of distilled water (Water for analysis EMSURE®, Cat.No. 116754, is recommended) into a second test tube.
(Blank)

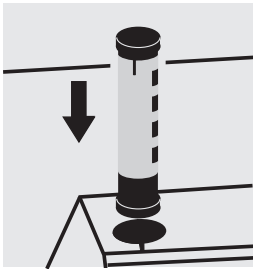


Add to each tube 1.0 ml of **F-1** with pipette and mix.

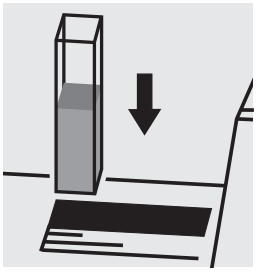
Reaction time:
1 minute



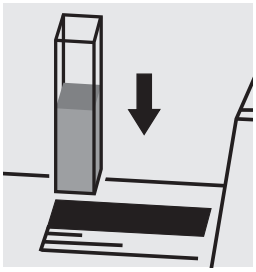
Transfer both solutions into a separate **semi-microcell**.



Select method with AutoSelector.



Place the blank cell into the cell compartment.



Place the cell containing the sample into the cell compartment.

Important:

For measurement in the 50-mm **rectangular cell** the sample volume and the volume of the reagent must be doubled for each.

Quality assurance:

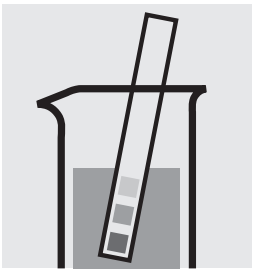
To check the measurement system (test reagents, measurement device, and handling) ready-for-use fluoride standard solution Certipur®, Cat.No. 119814, concentration 1000 mg/l F^-, can be used after diluting accordingly.

Formaldehyde

114500

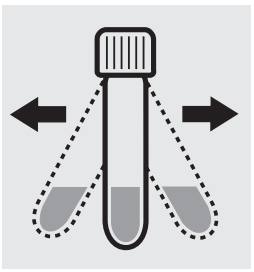
Cell Test

Measuring range:	0.10 – 8.00 mg/l HCHO Expression of results also possible in mmol/l.

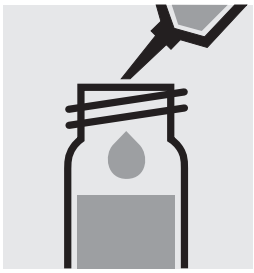


Check the pH of the sample, specified range: pH 0 – 13.

Add 1 level green microspoon of **HCHO-1K** into a reaction cell, close with the screw cap.

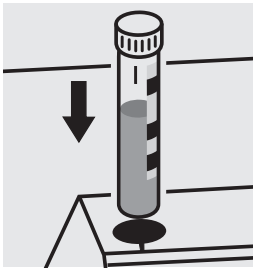


Shake the cell vigorously to dissolve the solid substance.



Add 2.0 ml of the sample with pipette, close the cell with the screw cap, and mix. **Caution, cell becomes hot!**

Reaction time: 5 minutes



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

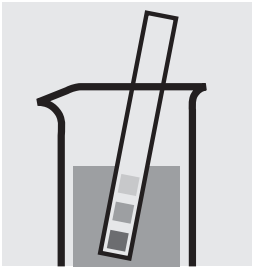
To check the measurement system (test reagents, measurement device, and handling) a formaldehyde standard solution must be prepared from Formaldehyde solution 37%, Cat.No. 104003 (see section “Standard solutions”).

Formaldehyde

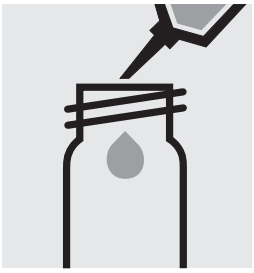
114678

Test

Measuring	0.10 – 8.00 mg/l HCHO	10-mm cell
range:	0.05 – 4.00 mg/l HCHO	20-mm cell
	0.02 – 1.50 mg/l HCHO	50-mm cell
	Expression of results also possible in mmol/l.	

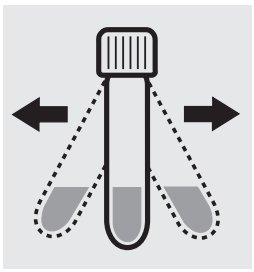


Check the pH of the sample, specified range: pH 0 – 13.

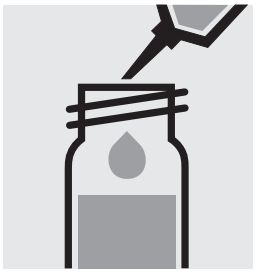


Pipette 4.5 ml of **HCHO-1** into an empty round cell (Empty cells, Cat.No. 114724).

Add 1 level green microspoon of **HCHO-2**, close the cell with the screw cap.

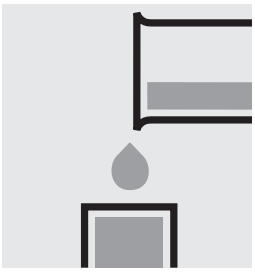


Shake the cell vigorously to dissolve the solid substance.

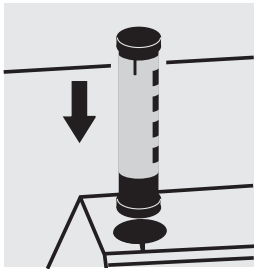


Add 3.0 ml of the sample with pipette, close the cell with the screw cap, and mix. **Caution, cell becomes hot!**

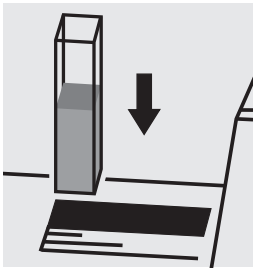
Reaction time: 5 minutes



Transfer the solution into a corresponding rectangular cell.



Select method with AutoSelector.



Place the cell into the cell compartment.

Note:

Empty cells with screw caps, Cat.No. 114724 are recommended for the preparation. These cells can be sealed with the screw caps, thus enabling a hazard-free mixing of the sample.

Quality assurance:

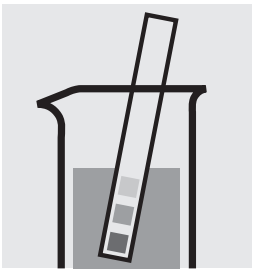
To check the measurement system (test reagents, measurement device, and handling) a formaldehyde standard solution must be prepared from Formaldehyde solution 37%, Cat.No. 104003 (see section “Standard solutions”).

Gold

114821

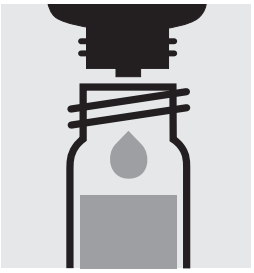
Test

Measuring	0.5 – 12.0 mg/l Au	10-mm cell
range:	Expression of results also possible in mmol/l.	

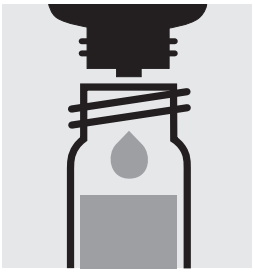


Check the pH of the sample, specified range: pH 1 – 9.
If required, add dilute hydrochloric acid drop by drop to adjust the pH.

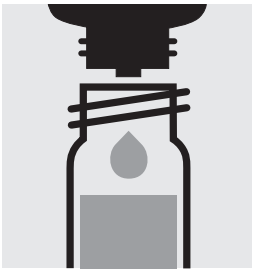
Pipette 2.0 ml of the sample into a test tube with screw cap.



Add 2 drops of **Au-1** and mix.

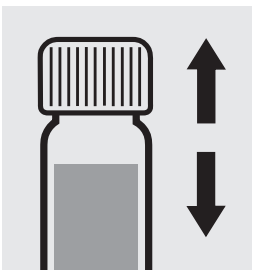


Add 4 drops of **Au-2** and mix.

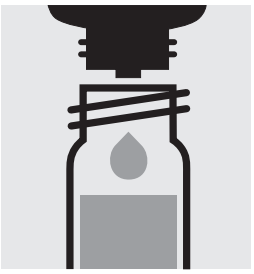


Add 6 drops of **Au-3** and mix.

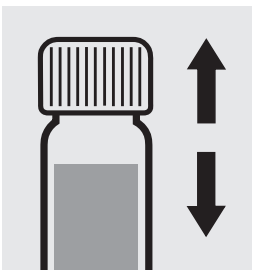
Add 6.0 ml of **Au-4** with pipette, close with the screw cap.



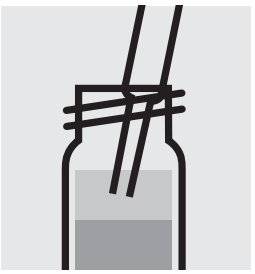
Shake the tube vigorously for 1 minute.



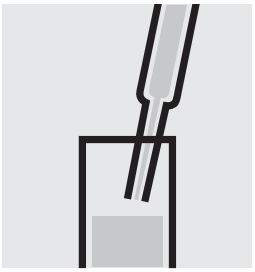
Add 6 drops of **Au-5**, close with the screw cap.



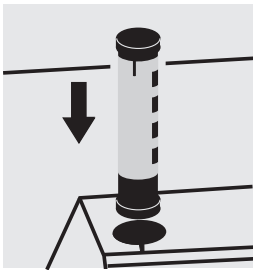
Shake the tube vigorously for 1 minute.



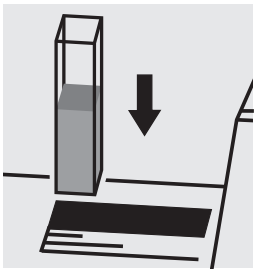
Aspirate the clear upper phase from the tube with pipette.



Transfer the solution into a cell.



Select method with AutoSelector.



Place the cell into the cell compartment.

Quality assurance:

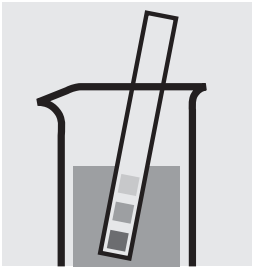
To check the measurement system (test reagents, measurement device, and handling) ready-for-use gold standard solution Certipur®, Cat.No. 170216, concentration 1000 mg/l Au, can be used after diluting accordingly.

Hydrazine

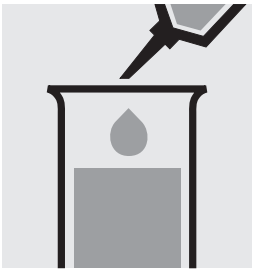
109711

Test

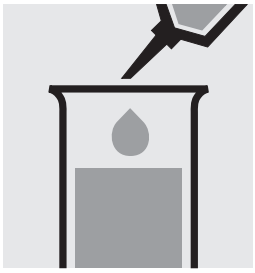
Measuring	0.02 – 2.00 mg/l N_2H_4	10-mm cell
range:	0.01 – 1.00 mg/l N_2H_4	20-mm cell
	0.005 – 0.400 mg/l N_2H_4	50-mm cell
	Expression of results also possible in mmol/l.	



Check the pH of the sample, specified range: pH 2 – 10.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.

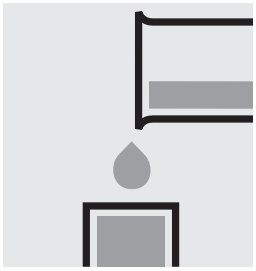


Pipette 5.0 ml of the sample into a test tube.

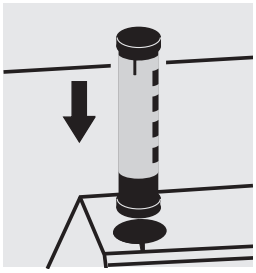


Add 2.0 ml of **Hy-1** with pipette and mix.

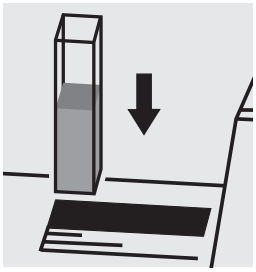
Reaction time:
5 minutes



Transfer the solution into a corresponding cell.



Select method with AutoSelector.



Place the cell into the cell compartment.

Important:

To measure in the 50-mm cell, the sample volume and the volume of the reagents have to be doubled for each. Alternatively, the semi-microcell, Cat.No. 173502, can be used.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) a hydrazine standard solution must be prepared from Hydrazinium sulfate GR, Cat.No. 104603 (see section “Standard solutions”).

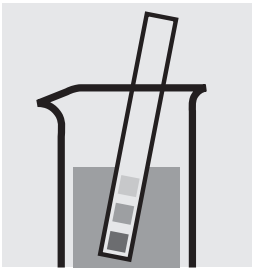
Hydrogen Peroxide

114731

Cell Test

Measuring	2.0 – 20.0 mg/l H_2O_2	Round cell
range:	0.25 – 5.00 mg/l H_2O_2	50-mm cell
	Expression of results also possible in mmol/l.	

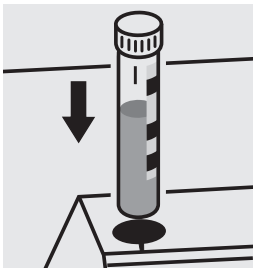
Measuring range: 2.0 – 20.0 mg/l H_2O_2



Check the pH of the sample, specified range: pH 0 – 10.
If required, add dilute sulfuric acid drop by drop to adjust the pH.

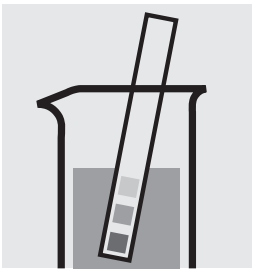
Pipette 10 ml of the sample into a reaction cell, close with the screw cap, and mix.

Reaction time:
2 minutes



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Measuring range: 0.25 – 5.00 mg/l H_2O_2

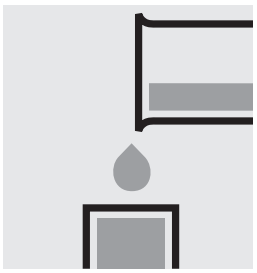


Check the pH of the sample, specified range: pH 0 – 10.
If required, add dilute sulfuric acid drop by drop to adjust the pH.

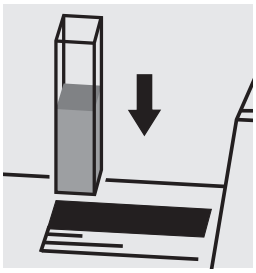
Select method **H_2O_2 sens** in the menu (method no. 128).

Pipette 10 ml of the sample into a reaction cell, close with the screw cap, and mix.

Reaction time:
2 minutes



Transfer the solution into a 50-mm cell.



Place the cell into the cell compartment.

Important:

The contents of the reaction cells may be slightly yellow. However, this does not influence the measurement result.

Quality assurance:

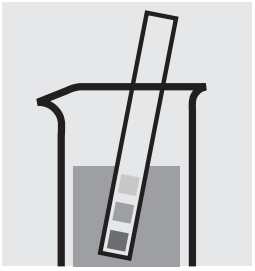
To check the measurement system (test reagents, measurement device, and handling) a hydrogenperoxide standard solution must be prepared from Perhydrol® 30% H_2O_2 GR, Cat.No. 107209 (see section “Standard solutions”).

Hydrogen Peroxide

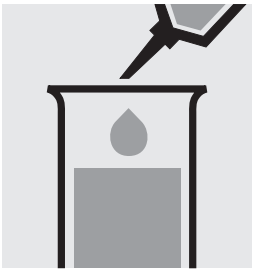
118789

Test

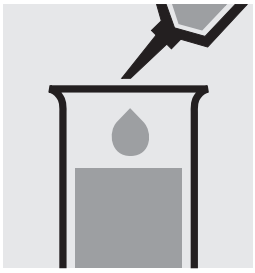
Measuring	0.03 – 6.00 mg/l H_2O_2	10-mm cell
range:	0.015 – 3.000 mg/l H_2O_2	20-mm cell
	Expression of results also possible in mmol/l.	



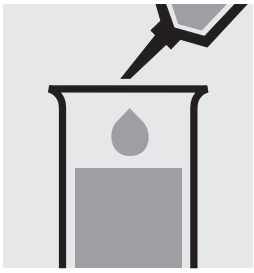
Check the pH of the sample, specified range: pH 4 – 10.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.



Pipette 0.50 ml of **H_2O_2-1** into a test tube.

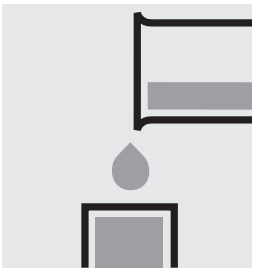


Add 8.0 ml of the sample with pipette and mix.

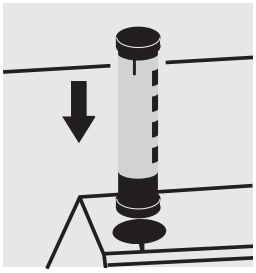


Add 0.50 ml of **H_2O_2-2** with pipette and mix.

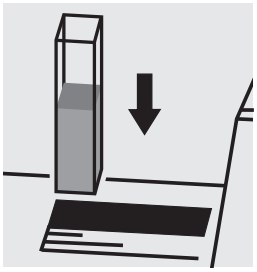
Reaction time: 10 minutes



Transfer the solution into a corresponding cell.



Select method with AutoSelector.



Place the cell into the cell compartment.

Quality assurance:

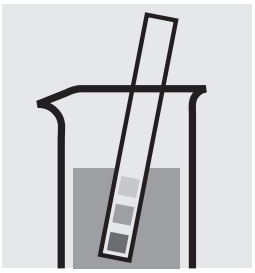
To check the measurement system (test reagents, measurement device, and handling) a hydrogenperoxide standard solution must be prepared from Perhydrol® 30% H_2O_2 GR, Cat.No. 107209 (see section “Standard solutions”).

Iodine

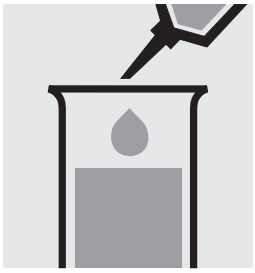
100606

Test

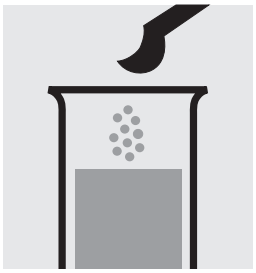
Measuring	0.20 – 10.00 mg/l I_2	10-mm cell
range:	0.10 – 5.00 mg/l I_2	20-mm cell
	0.050– 2.000 mg/l I_2	50-mm cell
	Expression of results also possible in mmol/l.	



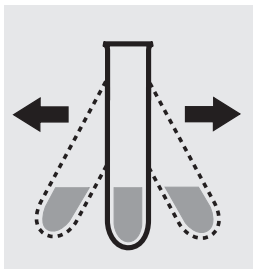
Check the pH of the sample, specified range: pH 4 – 8.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.



Pipette 10 ml of the sample into a test tube.

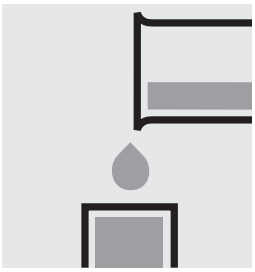


Add 1 level blue micro-spoon of **I_2-1**.

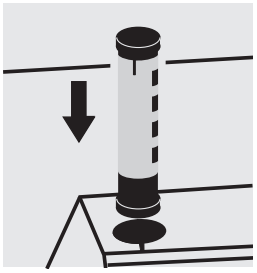


Shake vigorously to dissolve the solid substance.

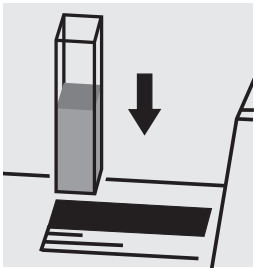
Reaction time: 1 minute



Transfer the solution into a corresponding cell.



Select method with AutoSelector.



Place the cell into the cell compartment.

Important:

Very high iodine concentrations in the sample produce yellow-colored solutions (measurement solution should be red) and false-low readings are yielded. In such cases the sample must be diluted (plausibility check).

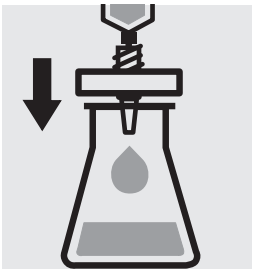
Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) a freshly prepared standard solution can be used (see section “Standard solutions”).

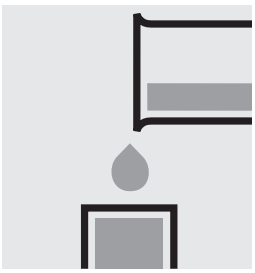
Iodine Color Number

analogous to **DIN 6162A**

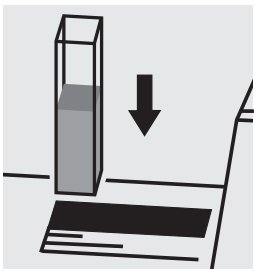
Measuring	0.05 – 3.00	340 nm	10-mm cell
range:	0.03 – 1.50	340 nm	20-mm cell
	0.010 – 0.600	340 nm	50-mm cell



Filter turbid samples.



Transfer the solution into a corresponding cell.

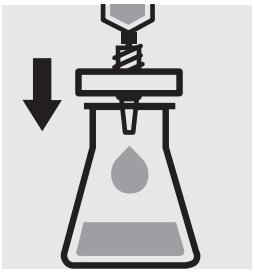


Place the cell into the cell compartment, select method no. **33**.

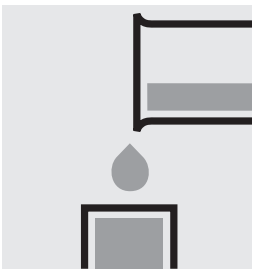
Iodine Color Number

analogous to **DIN 6162A**

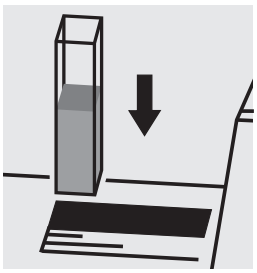
Measuring	1.0 – 50.0	445 nm	10-mm cell
range:	0.5 – 25.0	445 nm	20-mm cell
	0.2 – 10.0	445 nm	50-mm cell



Filter turbid samples.



Transfer the solution into a corresponding cell.



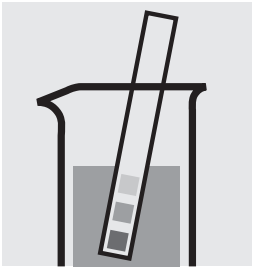
Place the cell into the cell compartment, select method no. **21**.

Iron

114549

Cell Test

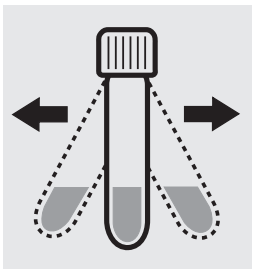
Measuring range:	0.05 – 4.00 mg/l Fe Expression of results also possible in mmol/l.



Check the pH of the sample, specified range: pH 1 – 10.
If required, add dilute sodium hydroxide solution or hydrochloric acid drop by drop to adjust the pH.

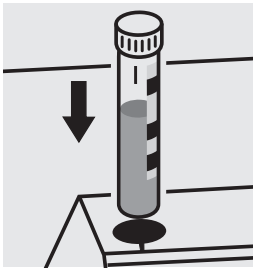
Pipette 5.0 ml of the sample into a reaction cell, close with the screw cap, and mix.

Add 1 level blue micro-spoon of **Fe-1K**, close the cell with the screw cap.



Shake the cell vigorously to dissolve the solid substance.

Reaction time: 3 minutes



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Important:

For the determination of **total iron** a pretreatment with Crack Set 10C, Cat.No. 114688, or Crack Set 10, Cat.No. 114687 and thermoreactor is necessary.

Result can be expressed as sum of iron (Σ Fe).

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) we recommended to use Spectroquant® CombiCheck 30, Cat.No. 114677.

Ready-for-use iron standard solution Certipur®, Cat.No. 119781, concentration 1000 mg/l Fe, can also be used after diluting accordingly.

To check for sample-dependent effects the use of addition solutions (e.g. in CombiCheck 30) is highly recommended.

Iron

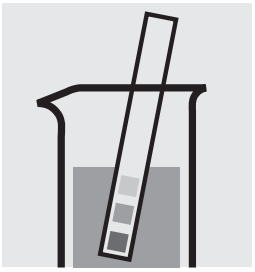
Determination of iron(II) and iron(III)

114896

Cell Test

Measuring range:	1.0 – 50.0 mg/l Fe Expression of results also possible in mmol/l and also in Fe(II), Fe(III).

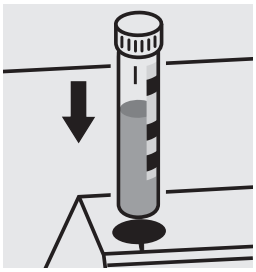
Determination of iron (II)



Check the pH of the sample, specified range: pH 3 – 8.
If required, add dilute sodium hydroxide solution or hydrochloric acid drop by drop to adjust the pH.

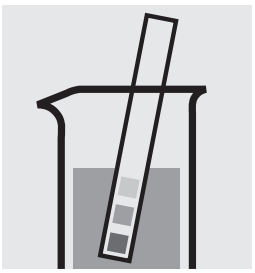
Pipette 1.0 ml of the sample into a reaction cell, close with the screw cap, and mix.

Reaction time:
5 minutes



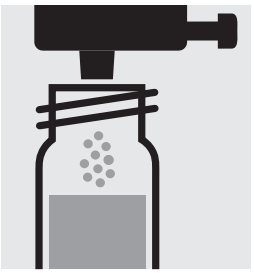
Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Determination of iron (II + III)

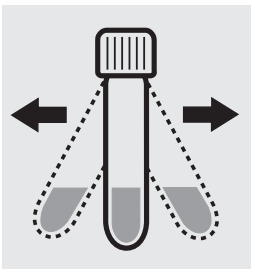


Check the pH of the sample, specified range: pH 3 – 8.
If required, add dilute sodium hydroxide solution or hydrochloric acid drop by drop to adjust the pH.

Pipette 1.0 ml of the sample into a reaction cell, close with the screw cap, and mix.

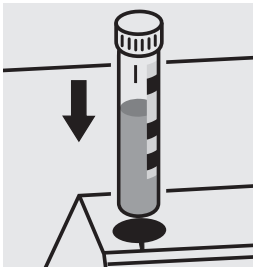


Add 1 dose of **Fe-1K** using the blue dose-metering cap, close the reaction cell with the screw cap.



Shake the cell vigorously to dissolve the solid substance.

Reaction time:
5 minutes



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

A differentiation between iron(II) and iron(III) can be performed on the photometer. Prior to measuring, select the differentiation measurement and choose the corresponding citation form.
Then measure the iron(II + III) (result for "Fe total" is shown on the display), press enter and measure the iron(II). The individual measuring values for Fe II and Fe III are shown on the display.

Important:

For the determination of **total iron** a pretreatment with Crack Set 10C, Cat.No. 114688, or Crack Set 10, Cat.No. 114687, and thermoreactor is necessary.

Result can be expressed as sum of iron (Σ Fe).

Quality assurance:

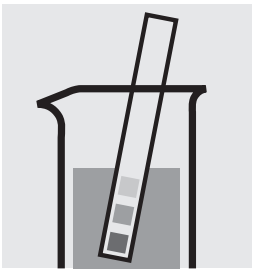
To check the measurement system (test reagents, measurement device, and handling) ready-for-use iron standard solution Certipur®, Cat.No. 119687, concentration 1000 mg/l Fe(III), can be used after diluting accordingly.

Iron

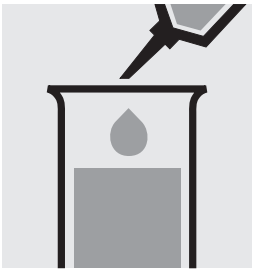
114761

Test

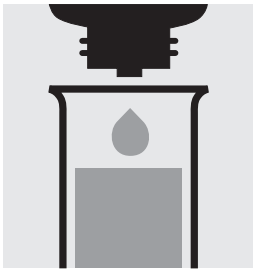
Measuring	0.05 – 5.00 mg/l Fe	10-mm cell
range:	0.03 – 2.50 mg/l Fe	20-mm cell
	0.005 – 1.000 mg/l Fe	50-mm cell
	Expression of results also possible in mmol/l.	



Check the pH of the sample, specified range: pH 1 – 10.
If required, add dilute sodium hydroxide solution or hydrochloric acid drop by drop to adjust the pH.

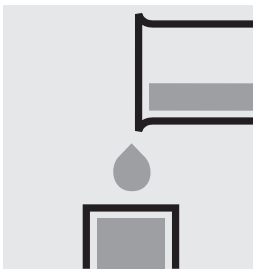


Pipette 5.0 ml of the sample into a test tube.

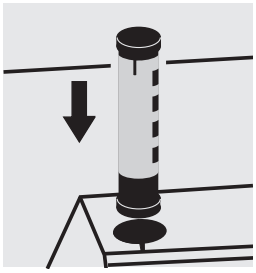


Add 3 drops of **Fe-1** and mix.

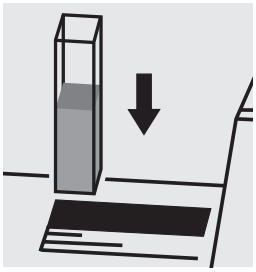
Reaction time: 3 minutes



Transfer the solution into a corresponding cell.



Select method with AutoSelector.



Place the cell into the cell compartment.

Important:

For the determination of **total iron** a pretreatment with Crack Set 10C, Cat.No. 114688, or Crack Set 10, Cat.No. 114687 and thermoreactor is necessary.

Result can be expressed as sum of iron (Σ Fe).

To measure in the 50-mm cell, the sample volume and the volume of the reagents have to be doubled for each.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) we recommended to use Spectroquant® CombiCheck 30, Cat.No. 114677.

Ready-for-use iron standard solution Certipur®, Cat.No. 119781, concentration 1000 mg/l Fe, can also be used after diluting accordingly.

To check for sample-dependent effects the use of addition solutions (e.g. in CombiCheck 30) is highly recommended.

Iron

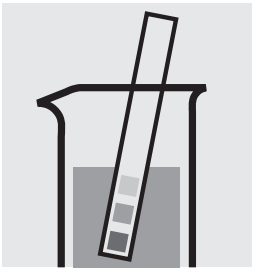
Determination of iron(II) and iron(III)

100796

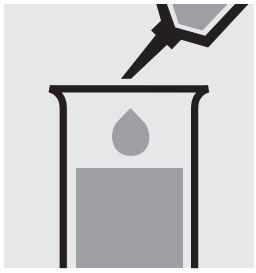
Test

Measuring	0.10 – 5.00 mg/l Fe	10-mm cell
range:	0.05 – 2.50 mg/l Fe	20-mm cell
	0.010 – 1.000 mg/l Fe	50-mm cell
	Expression of results also possible in mmol/l.	

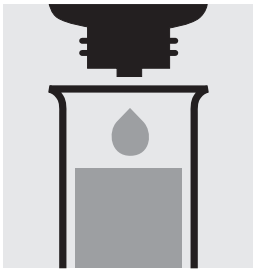
Determination of iron(II)



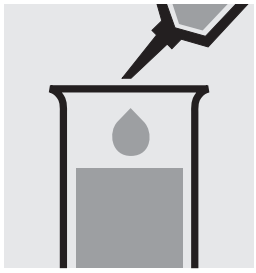
Check the pH of the sample, specified range: pH 2 – 8.
If required, add dilute sodium hydroxide solution or nitric acid drop by drop to adjust the pH.



Pipette 8.0 ml of the sample into a test tube.

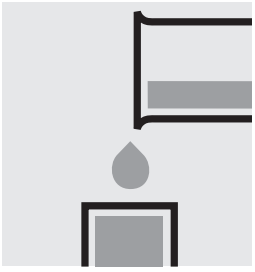


Add 1 drop of **Fe-1** and mix.

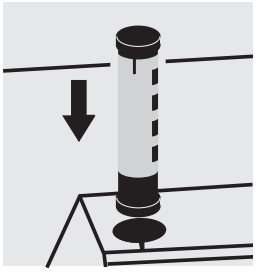


Add 0.50 ml of **Fe-2** with pipette and mix.

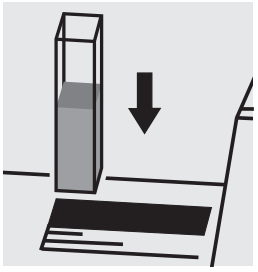
Reaction time: 5 minutes



Transfer the solution into a corresponding cell.



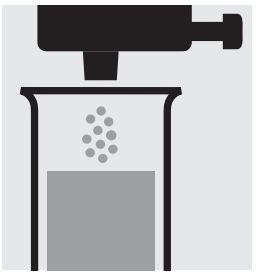
Select method with AutoSelector.



Place the cell into the cell compartment.

Determination of iron(II + III)

Same preparation as discribed above. After adding of **Fe-2** continue with **Fe-3**.



Add 1 dose of **Fe-3** using the blue dosemetering cap and dissolve the solid substance.

Reaction time: 10 minutes, then measure.

A differentiation between iron(II) and iron(III) can be performed on the photometer. Prior to measuring, select the differentiation measurement and choose the corresponding citation form.
Then measure the iron(II) (result for "Fe II" is shown on the display), press enter and measure the iron(II + III). The individual measuring values for Fe total and Fe III are shown on the display.

Important:

For the determination of **total iron** a pretreatment with Crack Set 10C, Cat.No. 114688, or Crack Set 10, Cat.No. 114687 and thermoreactor is necessary.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) we recommended to use Spectroquant® CombiCheck 30, Cat.No. 114677.

Ready-for-use iron standard solution Certipur®, Cat.No. 119781, concentration 1000 mg/l Fe(III), can also be used after diluting accordingly.

To check for sample-dependent effects the use of addition solutions (e.g. in CombiCheck 30) is highly recommended.

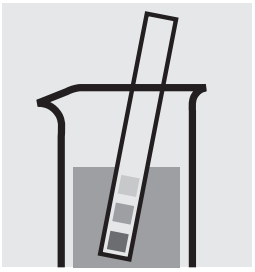
Lead

114833

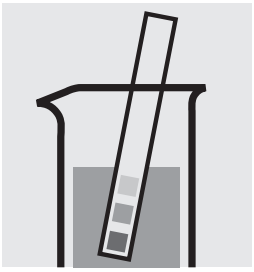
Cell Test

Measuring range:	0.10 – 5.00 mg/l Pb Expression of results also possible in mmol/l.

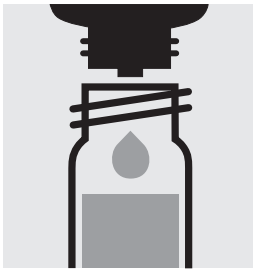
Samples of total hardness 0 – 10 °d



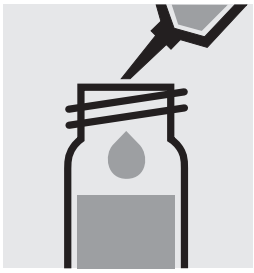
Check the total hardness of the sample.



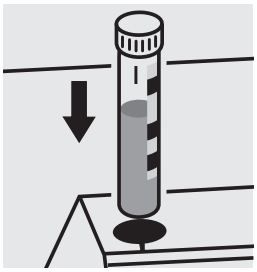
Check the pH of the sample, specified range: pH 3 – 6.
If required, add dilute ammonia solution or nitric acid drop by drop to adjust the pH.



Add 5 drops of **Pb-1K** into a reaction cell and mix.



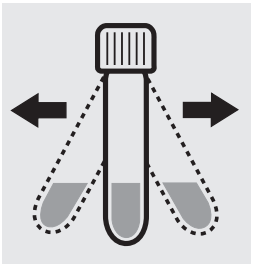
Add 5.0 ml of the sample with pipette, close the cell with the screw cap, and mix.



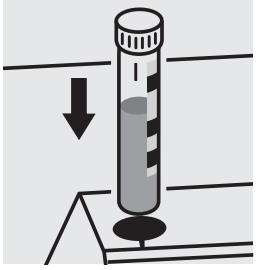
Place the cell into the cell compartment. Align the mark on the cell with that on the photometer
= Result A

Samples of total hardness > 10 °d

Add 1 level grey micro-spoon of **Pb-2K** to the already measured cell, close the cell with the screw cap.



Shake the cell vigorously to dissolve the solid substance.



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer
= Result B

Result A
– Result B
= mg/l Pb

Important:

For the determination of **total lead** a pretreatment with Crack Set 10C, Cat.No. 114688, or Crack Set 10, Cat.No. 114687, and thermoreactor is necessary.

Result can be expressed as sum of lead (Σ Pb).

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) we recommended to use Spectroquant® CombiCheck 40, Cat.No. 114692.

Ready-for-use lead standard solution Certipur®, Cat.No. 119776, concentration 1000 mg/l Pb, can also be used after diluting accordingly.

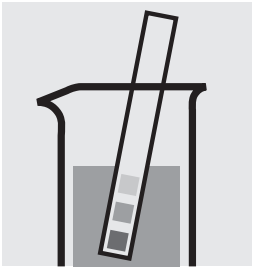
To check for sample-dependent effects the use of addition solutions (e.g. in CombiCheck 40) is highly recommended.

Lead

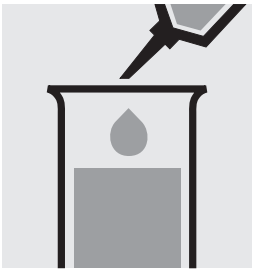
109717

Test

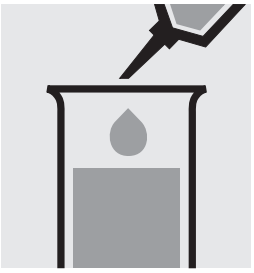
Measuring	0.10 – 5.00 mg/l Pb	10-mm cell
range:	0.05 – 2.50 mg/l Pb	20-mm cell
	0.010 – 1.000 mg/l Pb	50-mm cell
	Expression of results also possible in mmol/l.	



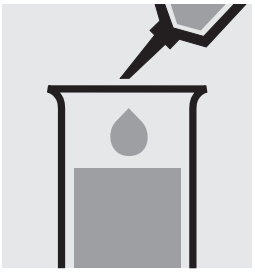
Check the pH of the sample, specified range: pH 3 – 6.
If required, add dilute ammonia solution or nitric acid drop by drop to adjust the pH.



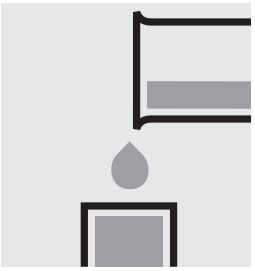
Pipette 0.50 ml of **Pb-1** into a test tube.



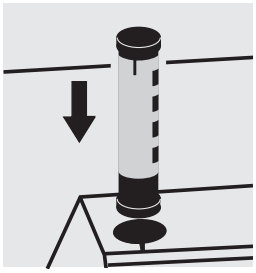
Add 0.50 ml of **Pb-2** with pipette and mix.



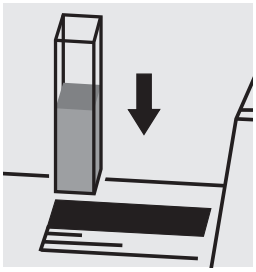
Add 8.0 ml of the sample with pipette and mix.



Transfer the solution into a corresponding cell.



Select method with AutoSelector.



Place the cell into the cell compartment.

Important:

For the determination of **total lead** a pretreatment with Crack Set 10C, Cat.No. 114688, or Crack Set 10, Cat.No. 114687, and thermoreactor is necessary.

Result can be expressed as sum of lead (Σ Pb).

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) we recommended to use Spectroquant® CombiCheck 40, Cat.No. 114692.

Ready-for-use lead standard solution Certipur®, Cat.No. 119776, concentration 1000 mg/l Pb, can also be used after diluting accordingly.

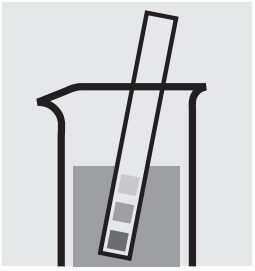
To check for sample-dependent effects the use of addition solutions (e.g. in CombiCheck 40) is highly recommended.

Magnesium

100815

Cell Test

Measuring range:	5.0 – 75.0 mg/l Mg Expression of results also possible in mmol/l.

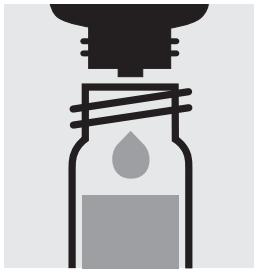


Check the pH of the sample, specified range: pH 3 – 9.
If required, add dilute sodium hydroxide solution or hydrochloric acid drop by drop to adjust the pH.

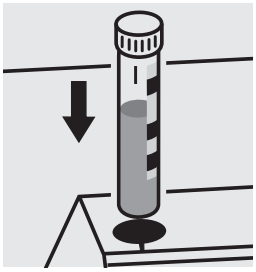
Pipette 1.0 ml of the sample into a reaction cell, close with the screw cap, and mix.

Add 1.0 ml of **Mg-1K** with pipette, close the cell with the screw cap, and mix.

Reaction time:
exactly 3 minutes



Add 3 drops of **Mg-2K**, close the cell with the screw cap and mix.



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

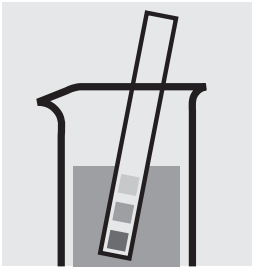
To check the measurement system (test reagents, measurement device, and handling) a freshly prepared standard solution can be used (see section “Standard solutions”).

Manganese

100816

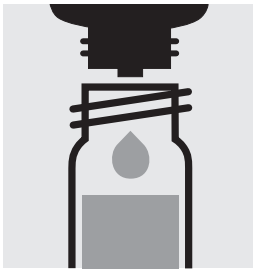
Cell Test

Measuring range:	0.10 – 5.00 mg/l Mn Expression of results also possible in mmol/l.



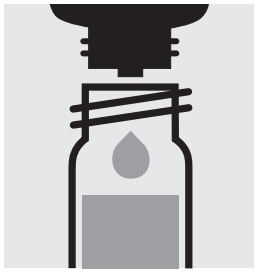
Check the pH of the sample, specified range: pH 2 – 7.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.

Pipette 7.0 ml of the sample into a reaction cell, close with the screw cap, and mix.



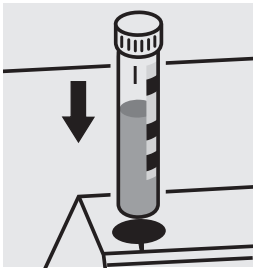
Add 2 drops of **Mn-1K**, close the cell with the screw cap, and mix.

Reaction time:
2 minutes



Add 3 drops of **Mn-2K**, close the cell with the screw cap, and mix.

Reaction time:
5 minutes



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) we recommended to use Spectroquant® CombiCheck 30, Cat.No. 114677.

Ready-for-use manganese standard solution Certipur®, Cat.No. 119789, concentration 1000 mg/l Mn, can also be used after diluting accordingly.

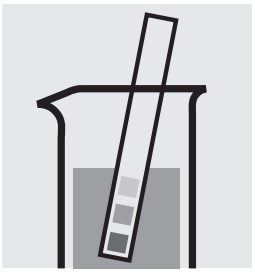
To check for sample-dependent effects the use of addition solutions (e.g. in CombiCheck 30) is highly recommended.

Manganese

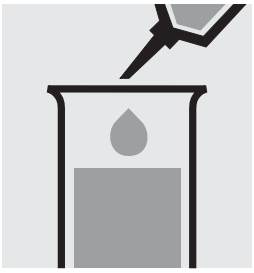
101739

Test

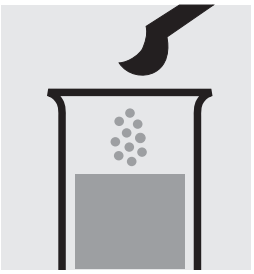
Measuring range:	0.05 – 2.00 mg/l Mn	10-mm cell
	0.03 – 1.00 mg/l Mn	20-mm cell
	0.005 – 0.400 mg/l Mn	50-mm cell
	Expression of results also possible in mmol/l.	



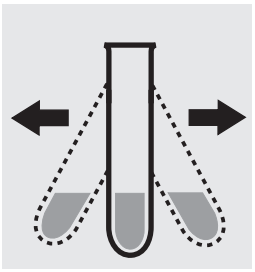
Check the pH of the sample, specified range: pH 3 – 10.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.



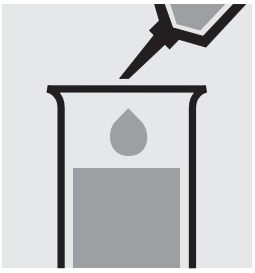
Pipette 8.0 ml of the sample into a test tube.



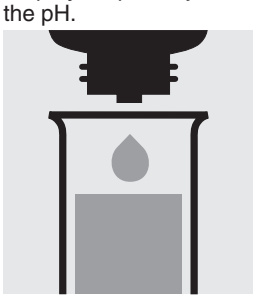
Add 1 level grey micro-spoon of **Mn-1**.



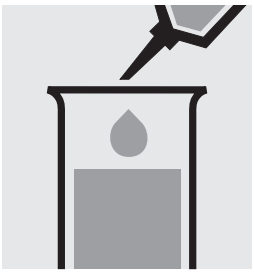
Shake the tube vigorously to dissolve the solid substance.



Add 2.0 ml of **Mn-2** with pipette and mix.

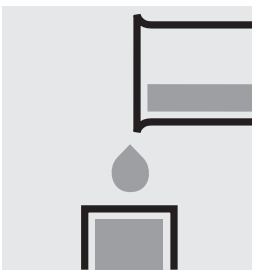


Add 3 drops of **Mn-3** and mix.

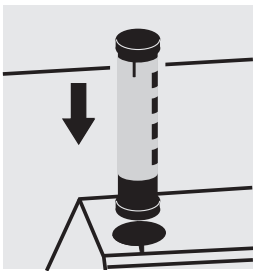


Add **swiftly** 0.25 ml of **Mn-4** with pipette and mix **immediately**.

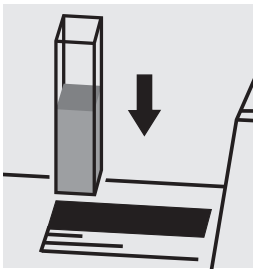
Reaction time:
10 minutes



Transfer the solution into a corresponding cell.



Select method with AutoSelector.



Place the cell into the cell compartment.

Important:

When using the 50-mm cell, perform the measurement against a separately prepared blank (preparation as per measurement sample, but with distilled water instead of sample).

Quality assurance:

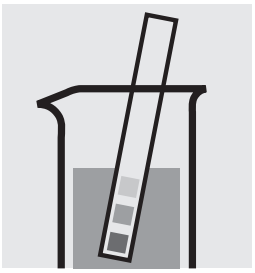
To check the measurement system (test reagents, measurement device, and handling) ready-for-use manganese standard solution Certipur®, Cat.No. 119789, concentration 1000 mg/l Mn, can be used after diluting accordingly.

Manganese

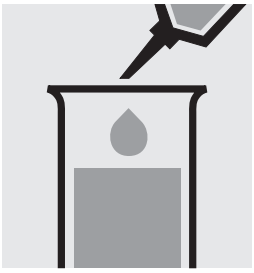
114770

Test

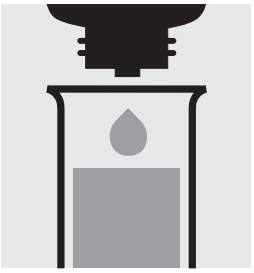
Measuring	0.50 – 10.00 mg/l Mn	10-mm cell
range:	0.25 – 5.00 mg/l Mn	20-mm cell
	0.010 – 2.000 mg/l Mn	50-mm cell
	Expression of results also possible in mmol/l.	



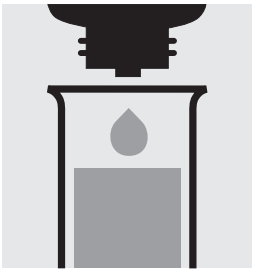
Check the pH of the sample, specified range: pH 2 – 7.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.



Pipette 5.0 ml of the sample into a test tube.

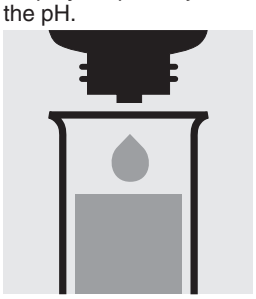


Add 4 drops of **Mn-1** and mix.
Check the pH, specified pH: approx. 11.5.



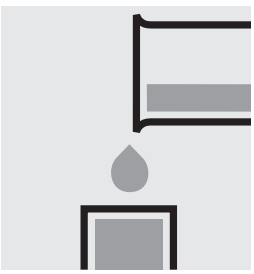
Add 2 drops of **Mn-2** and mix.

Reaction time: 2 minutes

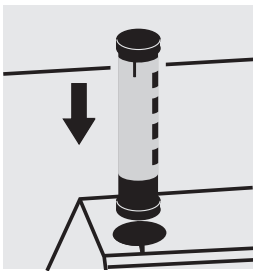


Add 2 drops of **Mn-3** and mix.

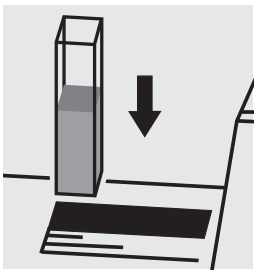
Reaction time: 2 minutes



Transfer the solution into a corresponding cell.



Select method with AutoSelector.



Place the cell into the cell compartment.

Important:

To measure in the 50-mm cell, the sample volume and the volume of the reagents have to be doubled for each. Alternatively, the semi-microcell, Cat.No. 173502, can be used.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) we recommended to use Spectroquant® CombiCheck 30, Cat.No. 114677.

Ready-for-use manganese standard solution Certipur®, Cat.No. 119789, concentration 1000 mg/l Mn, can also be used after diluting accordingly.

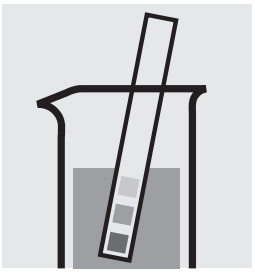
To check for sample-dependent effects the use of addition solutions (e.g. in CombiCheck 30) is highly recommended.

Manganese

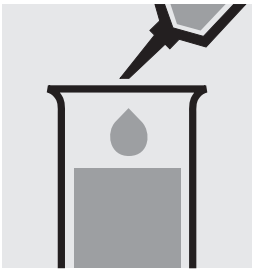
101846

Test

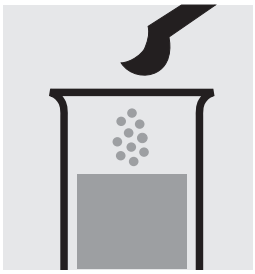
Measuring	0.05 – 2.00	mg/l Mn	10-mm cell
range:	0.03 – 1.00	mg/l Mn	20-mm cell
	0.005 – 0.400	mg/l Mn	50-mm cell
	Expression of results also possible in mmol/l.		



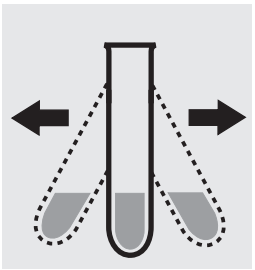
Check the pH of the sample, specified range: pH 3 – 10.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.



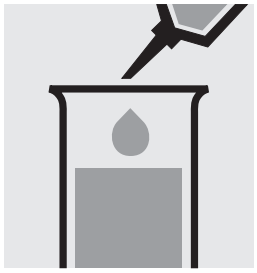
Pipette 8.0 ml of the sample into a test tube.



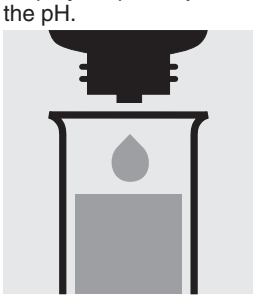
Add 1 level grey microspoon of **Mn-1**.



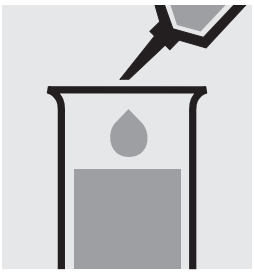
Shake the tube vigorously to dissolve the solid substance.



Add 2.0 ml of **Mn-2** with pipette and mix.

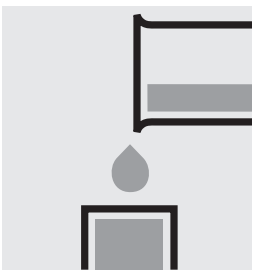


Add **carefully** 3 drops of **Mn-3** and mix.

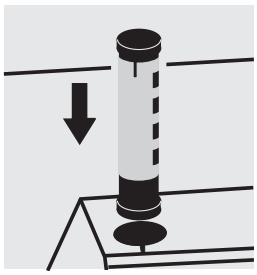


Add **carefully** 0.25 ml of **Mn-4** with pipette and mix **carefully** (**Foams! Wear eye protection!**).

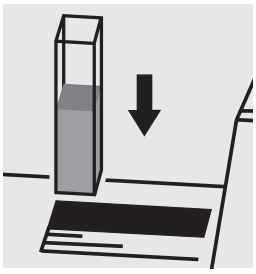
Reaction time:
10 minutes



Transfer the solution into a corresponding cell.



Select method with AutoSelector.



Place the cell into the cell compartment.

Important:

When using the 50-mm cell, perform the measurement against a separately prepared blank (preparation as per measurement sample, but with distilled water instead of sample).

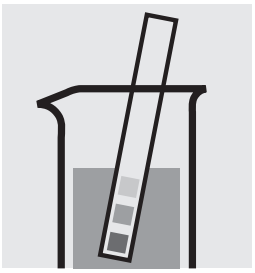
Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) ready-for-use manganese standard solution Certipur®, Cat.No. 119789, concentration 1000 mg/l Mn, can be used after diluting accordingly.

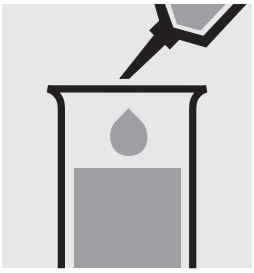
Mercury in water and wastewater

Application

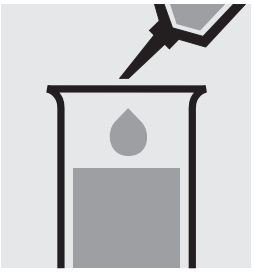
Measuring range: 0.025 – 1.000 mg/l Hg 50-mm cell



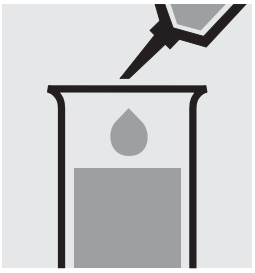
Check the pH of the sample, specified range: pH 3 – 7.
If required, add dilute sodium hydroxide solution or acetic acid drop by drop to adjust the pH.



Pipette 5.0 ml of the sample into a test tube.

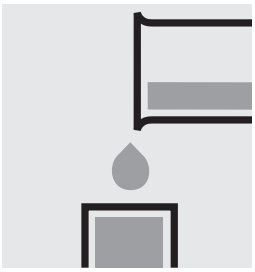


Add 1.0 ml of **reagent 1** with pipette and mix.

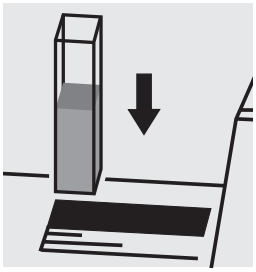


Add 1.5 ml of **reagent 2** with pipette and mix.

Reaction time: 5 minutes



Transfer the solution into a cell.



Place the cell into the cell compartment.
Select method no. **135**.

Important:

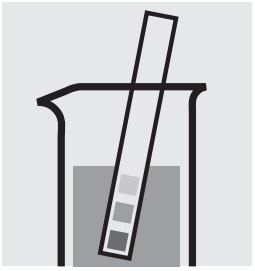
The exact composition and preparation of the reagents 1 and 2 used are given in the corresponding application, which also includes further information on the method employed. This application can be downloaded directly at www.analytical-test-kits.com.

Molybdenum

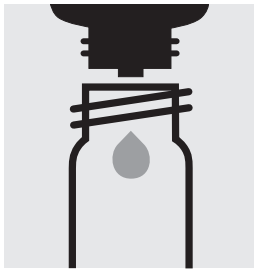
100860

Cell Test

Measuring range:	0.02 – 1.00 mg/l Mo
	0.03 – 1.67 mg/l MoO_4
	0.04 – 2.15 mg/l Na_2MoO_4
	Expression of results also possible in mmol/l.

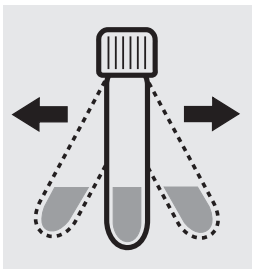


Check the pH of the sample, specified range: pH 1 – 10.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.



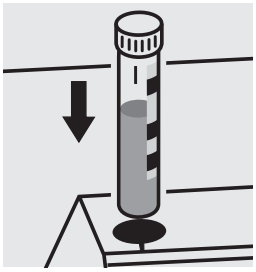
Place 2 drops of **Mo-1K** into a reaction cell and mix.

Add 10 ml of the sample with pipette, close the cell with the screw cap.



Shake the cell vigorously to dissolve the solid substance.

Reaction time: 2 minutes



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

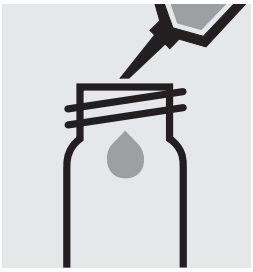
To check the measurement system (test reagents, measurement device, and handling) a ready-for-use molybdenum standard solution Certipur®, Cat.No. 170227, concentration 1000 mg/l Mo, can be used after diluting accordingly.

Molybdenum

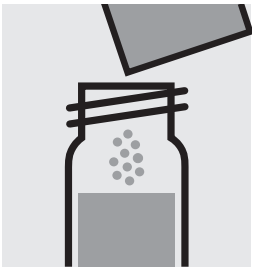
119252

Test

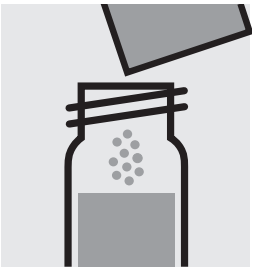
Measuring	0.5 – 45.0	mg/l Mo	20-mm cell
range:	0.8 – 75.0	mg/l MoO_4	20-mm cell
	1.1 – 96.6	mg/l Na_2MoO_4	20-mm cell
	Expression of results also possible in mmol/l.		



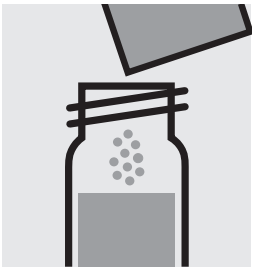
Pipette 10 ml of the sample into into a empty round cell (Empty cells, Cat.No. 114724).



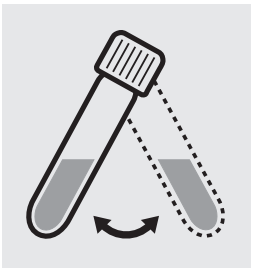
Add 1 powder pack of **Molybdenum HR1**, close with the screw cap, and dissolve the solid substance.



Add 1 powder pack of **Molybdenum HR2**, close with the screw cap, and dissolve the solid substance.

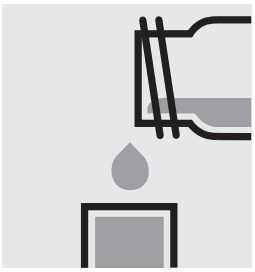


Add 1 powder pack of **Molybdenum HR3** and close with the screw cap.

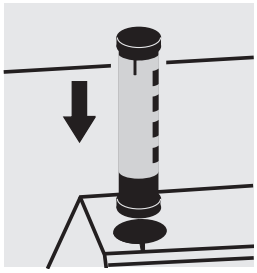


Swirl the cell to dissolve the solid substance.

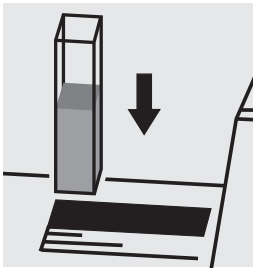
Reaction time:
5 minutes, **measure immediately**.



Transfer the solution into a rectangular cell.



Select method with AutoSelector.



Place the cell into the cell compartment.

Quality assurance:

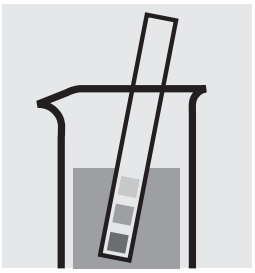
To check the measurement system (test reagents, measurement device, and handling) a ready-for-use molybdenum standard solution Certipur®, Cat.No. 170227, concentration 1000 mg/l Mo, can be used after diluting accordingly.

Monochloramine

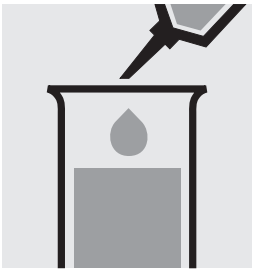
101632

Test

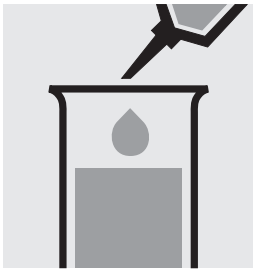
Measuring	0.25 – 10.00 mg/l Cl_2	0.18 – 7.26 mg/l NH_2Cl	0.05 – 1.98 mg/l NH_2Cl-N	10-mm cell
range:	0.13 – 5.00 mg/l Cl_2	0.09 – 3.63 mg/l NH_2Cl	0.026 – 0.988 mg/l NH_2Cl-N	20-mm cell
	0.050 – 2.000 mg/l Cl_2	0.04 – 1.45 mg/l NH_2Cl	0.010 – 0.395 mg/l NH_2Cl-N	50-mm cell
	Expression of results also possible in mmol/l.			



Check the pH of the sample, specified range: pH 4 – 13.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.

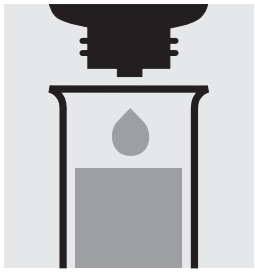


Pipette 10 ml of the sample into a test tube.



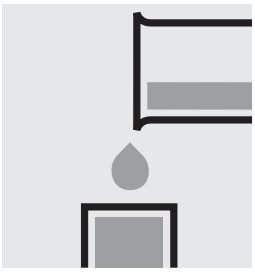
Add 0.60 ml of **MCA-1** with pipette and mix.

Reaction time:
5 minutes

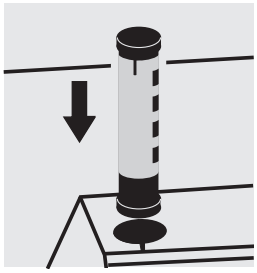


Add 4 drops of **MCA-2** and mix.

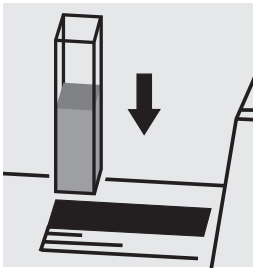
Reaction time:
10 minutes



Transfer the solution into a corresponding cell.



Select method with AutoSelector.



Place the cell into the cell compartment.

Important:

Very high monochloramine concentrations in the sample produce turquoise-colored solutions (measurement so-lution should be yellow-green to green) and false-low readings are yielded. In such cases the sample must be diluted (plausibility check).

Quality assurance:

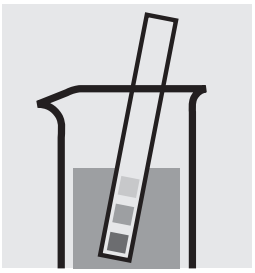
To check the measurement system (test reagents, measurement device, and handling) a standard solution must be prepared (see section “Standard solutions”).

Nickel

114554

Cell Test

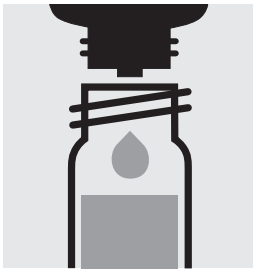
Measuring range:	0.10 – 6.00 mg/l Ni Expression of results also possible in mmol/l.



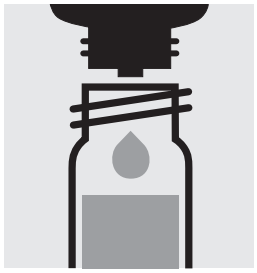
Check the pH of the sample, specified range: pH 3 – 8.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.

Pipette 5.0 ml of the sample into a reaction cell, close with the screw cap, and mix.

Reaction time:
1 minute

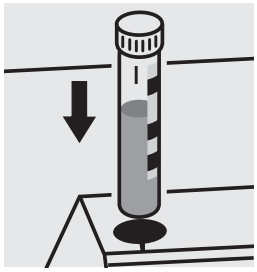


Add 2 drops of **Ni-1K**, close with the screw cap, and mix.



Add 2 drops of **Ni-2K**, close the cell with the screw cap, and mix.

Reaction time:
2 minutes



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Important:

For the determination of **total nickel** a pretreatment with Crack Set 10C, Cat.No. 114688, or Crack Set 10, Cat.No. 114687 and thermoreactor is necessary.

Result can be expressed as sum of nickel (Σ Ni).

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) we recommended to use Spectroquant® CombiCheck 40, Cat.No. 114692.

A nickel standard solution Titrisol®, Cat.No. 109989, can also be used after diluting accordingly.

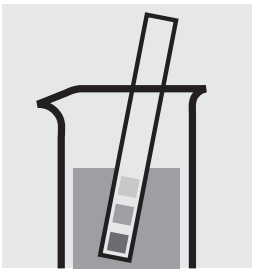
To check for sample-dependent effects the use of addition solutions (e.g. in CombiCheck 40) is highly recommended.

Nickel

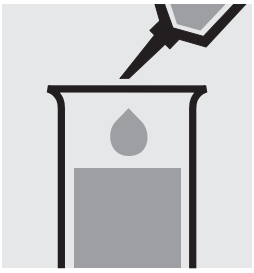
114785

Test

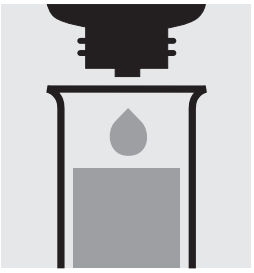
Measuring	0.10 – 5.00 mg/l Ni	10-mm cell
range:	0.05 – 2.50 mg/l Ni	20-mm cell
	0.02 – 1.00 mg/l Ni	50-mm cell
	Expression of results also possible in mmol/l.	



Check the pH of the sample, specified range: pH 3 – 8.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.

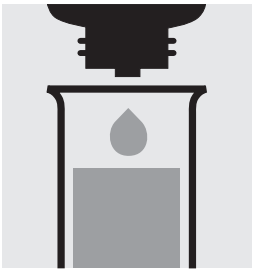


Pipette 5.0 ml of the sample into a test tube.

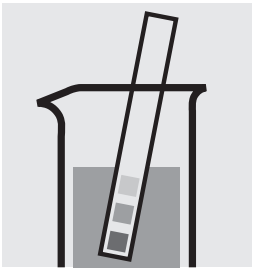


Add 1 drop of **Ni-1** and mix. If the color disappears, continue adding drop by drop until a slight yellow coloration persists.

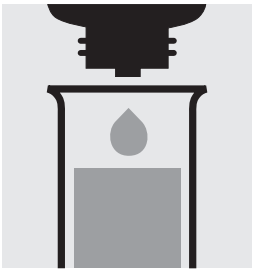
Reaction time:
1 minute



Add 2 drops of **Ni-2** and mix.

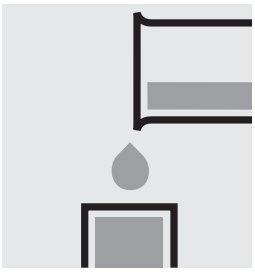


Check the pH, specified range: pH 10 – 12.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.

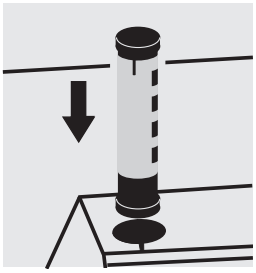


Add 2 drops of **Ni-3** and mix.

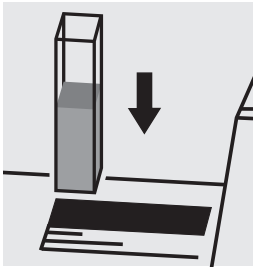
Reaction time:
2 minutes



Transfer the solution into a corresponding cell.



Select method with AutoSelector.



Place the cell into the cell compartment.

Important:

For the determination of **total nickel** a pretreatment with Crack Set 10C, Cat.No. 114688, or Crack Set 10, Cat.No. 114687 and thermoreactor is necessary.

Result can be expressed as sum of nickel (Σ Ni).

To measure in the 50-mm cell, the sample volume and the volume of the reagents have to be doubled for each. Alternatively, the semi-microcell, Cat.No. 173502, can be used.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) we recommended to use Spectroquant® CombiCheck 40, Cat.No. 114692.

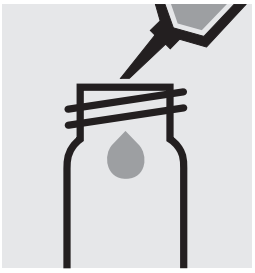
A nickel standard solution Titrisol®, Cat.No. 109989, can also be used after diluting accordingly.

To check for sample-dependent effects the use of addition solutions (e.g. in CombiCheck 40) is highly recommended.

Nickel in electroplating baths

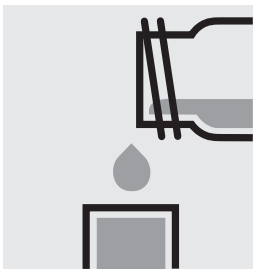
Inherent color

Measuring range:	10 – 120 g/l Ni	10-mm cell
	5.0 – 60.0 g/l Ni	20-mm cell
	2.0 – 24.0 g/l Ni	50-mm cell

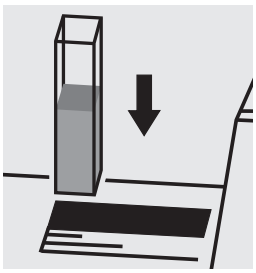


Pipette 5.0 ml of the sample into an empty round cell (Empty cells, Cat.No. 114724).

Add 5.0 ml of **sulfuric acid 40 %**, close the cell with the screw cap, and mix.



Transfer the solution into a corresponding rectangular cell.



Place the cell into the cell compartment. Select method no. **57**.

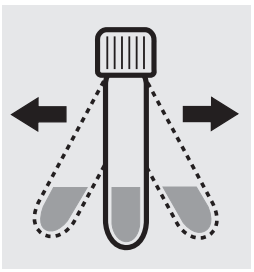
Nitrate

114542

Cell Test

Measuring range:	0.5 – 18.0 mg/l NO_3-N
	2.2 – 79.7 mg/l NO_3
	Expression of results also possible in mmol/l.

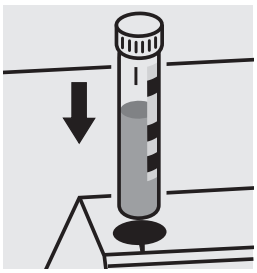
Add 1 level yellow microspoon of **NO_3-1K** into a reaction cell and close with the screw cap.



Shake the cell **vigorously for 1 minute** to dissolve the solid substance.

Add very slowly 1.5 ml of the sample with pipette, close the cell with the screw cap, and mix **briefly**.
Caution, cell becomes hot!

Reaction time:
10 minutes



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) we recommended to use Spectroquant® CombiCheck 20, Cat.No. 114675, or the Standard solution for photometric applications, CRM, Cat. No. 125037 and 125038.

Ready-for-use nitrate standard solution Certipur®, Cat.No. 119811, concentration 1000 mg/l NO_3^-, can also be used after diluting accordingly.

To check for sample-dependent effects the use of addition solutions (e.g. in CombiCheck 20) is highly recommended.

Nitrate

114563

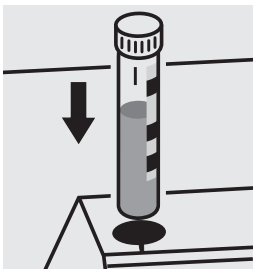
Cell Test

Measuring range:	0.5 – 25.0 mg/l NO_3-N
	2.2 – 110.7 mg/l NO_3
	Expression of results also possible in mmol/l.

Pipette 1.0 ml of the sample into a reaction cell, **do not mix**.

Add 1.0 ml of **NO_3-1K** with pipette, close the cell with the screw cap, and mix. **Caution, cell becomes hot!**

Reaction time: 10 minutes



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) we recommended to use Spectroquant® CombiCheck 20, Cat.No. 114675, or the Standard solution for photometric applications, CRM, Cat. No. 125037 and 125038.

Ready-for-use nitrate standard solution Certipur®, Cat.No. 119811, concentration 1000 mg/l NO_3^-, can also be used after diluting accordingly.

To check for sample-dependent effects the use of addition solutions (e.g. in CombiCheck 20) is highly recommended.

Nitrate

114764

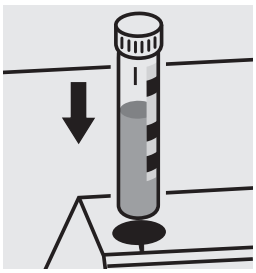
Cell Test

Measuring range:	1.0 – 50.0 mg/l NO_3-N 4 – 221 mg/l NO_3 Expression of results also possible in mmol/l.

Pipette 0.50 ml of the sample into a reaction cell, **do not mix**.

Add 1.0 ml of **NO_3-1K** with pipette, close the cell with the screw cap, and mix. **Caution, cell becomes hot!**

Reaction time: 10 minutes



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) we recommended to use Spectroquant® CombiCheck 80, Cat.No. 114738, or the Standard solution for photometric applications, CRM, Cat.No. 125037, 125038, and 125039.

Ready-for-use nitrate standard solution Certipur®, Cat.No. 119811, concentration 1000 mg/l NO_3^-, can also be used after diluting accordingly.

To check for sample-dependent effects the use of addition solutions (e.g. in CombiCheck 80) is highly recommended.

Nitrate

100614

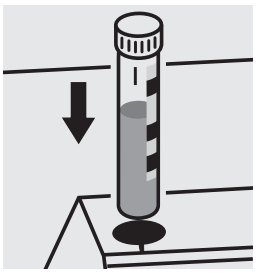
Cell Test

Measuring range:	23 – 225 mg/l NO_3-N
	102 – 996 mg/l NO_3
	Expression of results also possible in mmol/l.

Pipette 1.0 ml of **NO_3-1K** into a reaction cell, **do not mix**.

Add 0.10 ml of the sample with pipette, close the cell with the screw cap, and mix. **Caution, cell becomes hot!**

Reaction time: 5 minutes, **measure immediately**.



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) ready-for-use nitrate standard solution Certipur®, Cat.No. 119811, concentration 1000 mg/l NO_3^-, can be used after diluting accordingly as well as the Standard solution for photometric applications, CRM, Cat.No. 125039 and 125040.

Nitrate

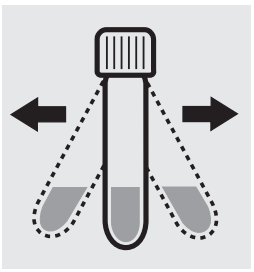
114773

Test

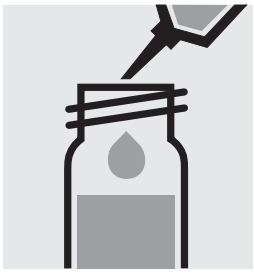
Measuring	0.5 – 20.0 mg/l NO_3-N	2.2 – 88.5 mg/l NO_3	10-mm cell
range:	0.2 – 10.0 mg/l NO_3-N	0.9 – 44.3 mg/l NO_3	20-mm cell
	Expression of results also possible in mmol/l.		

Place 1 blue microspoon of **NO_3-1** into a dry empty round cell (Empty cells, Cat.No. 114724).

Add 5.0 ml of **NO_3-2** with pipette into the cell. Close the cell with the screw cap.

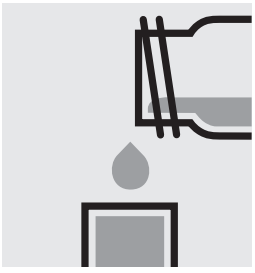


Shake vigorously for 1 minute to dissolve the solid substance.

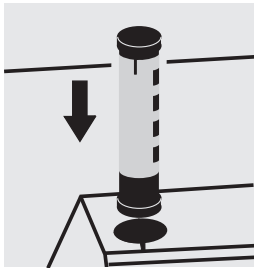


Add very slowly 1.5 ml of the sample with pipette, close the cell with the screw cap, and mix **briefly**.
Caution, cell becomes hot!

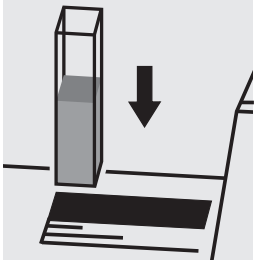
Reaction time: 10 minutes



Transfer the solution into a corresponding rectangular cell.



Select method with AutoSelector.



Place the cell into the cell compartment.

Note:

Empty cells with screw caps, Cat.No. 114724 are recommended for the preparation. These cells can be sealed with the screw caps, thus enabling a hazard-free mixing of the sample.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) we recommended to use Spectroquant® CombiCheck 10 and 20, Cat.No. 114676 and 114675, or the Standard solution for photometric applications, CRM, Cat.No. 125036, 125037, and 125038.

Ready-for-use nitrate standard solution Certipur®, Cat.No. 119811, concentration 1000 mg/l NO_3^-, can also be used after diluting accordingly.

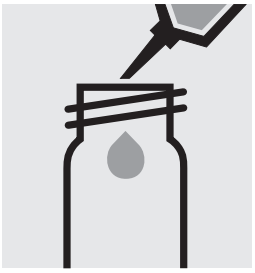
To check for sample-dependent effects the use of addition solutions (e.g. in CombiCheck) is highly recommended.

Nitrate

109713

Test

Measuring	1.0 – 25.0 mg/l NO_3-N	4.4 – 110.7 mg/l NO_3	10-mm cell
range:	0.5 – 12.5 mg/l NO_3-N	2.2 – 55.3 mg/l NO_3	20-mm cell
	0.10 – 5.00 mg/l NO_3-N	0.4 – 22.1 mg/l NO_3	50-mm cell
	Expression of results also possible in mmol/l.		

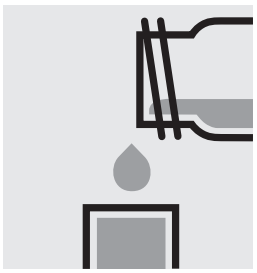


Pipette 4.0 ml of **NO_3-1** into a dry empty round cell (Empty cells, Cat. No. 114724).

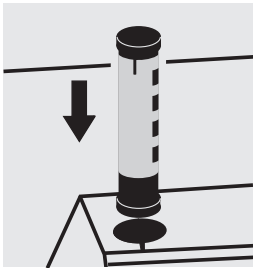
Add 0.50 ml of the sample with pipette, **do not mix.**

Add 0.50 ml of **NO_3-2** with pipette, close the cell with the screw cap, and mix. **Caution, cell becomes hot!**

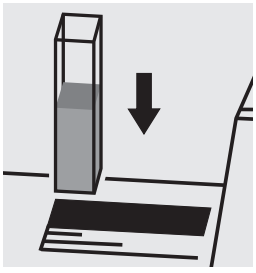
Reaction time: 10 minutes



Transfer the solution into a corresponding rectangular cell.



Select method with AutoSelector.



Place the cell into the cell compartment.

Important:

To measure in the 50-mm cell, the sample volume and the volume of the reagents have to be doubled for each. Alternatively, the semi-microcell, Cat.No. 173502, can be used.

Note:

Empty cells with screw caps, Cat.No. 114724 are recommended for the preparation. These cells can be sealed with the screw caps, thus enabling a hazard-free mixing of the sample.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) we recommended to use Spectroquant® CombiCheck 20, Cat.No. 114675, or the Standard solution for photometric applications, CRM, Cat.No. 125036, 125037, and 125038.

Ready-for-use nitrate standard solution Certipur®, Cat.No. 119811, concentration 1000 mg/l NO_3^-, can also be used after diluting accordingly.

To check for sample-dependent effects the use of addition solutions (e.g. in CombiCheck 20) is highly recommended.

Nitrate

in seawater

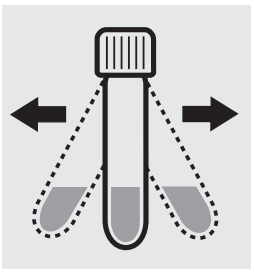
114556

Cell Test

Measuring range:	0.10 – 3.00 mg/l NO_3-N
	0.4 – 13.3 mg/l NO_3
	Expression of results also possible in mmol/l.

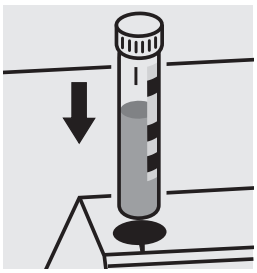
Pipette 2.0 ml of the sample into a reaction cell, **do not mix**.

Add 1 level blue micro-spoon of **NO_3-1K**, **immediately** close the cell tightly with the screw cap. **Caution, foams strongly (eye protection, protective gloves)!**



Shake the cell **vigorously for 5 seconds** to dissolve the solid substance.

Reaction time: 30 minutes



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) we recommended to use Spectroquant® CombiCheck 10, Cat.No. 114676, or the Standard solution for photometric applications, CRM, Cat.No. 125036 and 125037.

Ready-for-use nitrate standard solution Certipur®, Cat.No. 119811, concentration 1000 mg/l NO_3^-, can also be used after diluting accordingly.

To check for sample-dependent effects the use of addition solutions (e.g. in CombiCheck 10) is highly recommended.

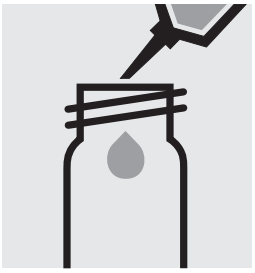
Nitrate

in seawater

114942

Test

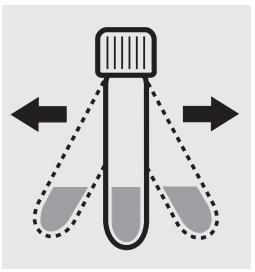
Measuring	0.2 – 17.0 mg/l NO_3-N	0.9 – 75.3 mg/l NO_3	10-mm cell
range:	Expression of results also possible in mmol/l.		



Pipette 5.0 ml of **NO_3-1** into a dry empty round cell (Empty cells, Cat. No. 114724).

Add 1.0 ml of the sample with pipette. **Caution, cell becomes hot!**

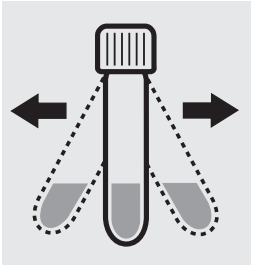
Immediately add 1.5 ml of **NO_3-2** with pipette.



Close cell tightly and shake **vigorously**.

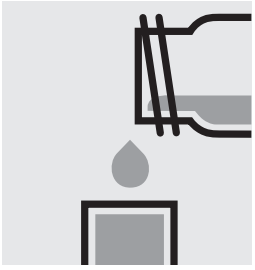
Reaction time: 15 minutes

Add 2 level grey micro-spoons of **NO_3-3**.

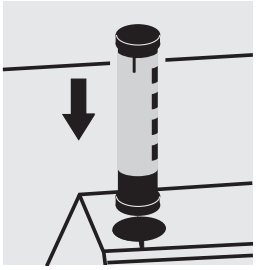


Close cell tightly and shake **vigorously** until the reagent is completely dissolved.

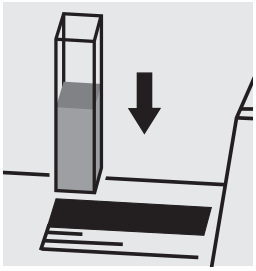
Reaction time: 60 minutes



Transfer the solution into a rectangular cell.



Select method with AutoSelector.



Place the cell into the cell compartment.

Important:

Empty cells with screw caps, Cat.No. 114724 are recommended for the preparation. These cells can be sealed with the screw caps, thus enabling a hazard-free mixing of the sample.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) we recommended to use Spectroquant® CombiCheck 20, Cat.No. 114675, or the Standard solution for photometric applications, CRM, Cat.No. 125036, 125037, and 125038.

Ready-for-use nitrate standard solution Certipur®, Cat.No. 119811, concentration 1000 mg/l NO_3^-, can also be used after diluting accordingly.

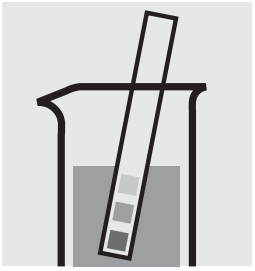
To check for sample-dependent effects the use of addition solutions (e.g. in CombiCheck 20) is highly recommended.

Nitrate

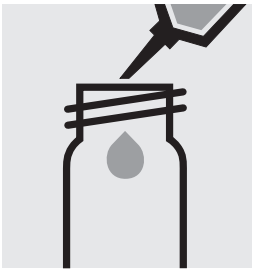
101842

Test

Measuring	0.3 – 30.0 mg/l NO_3-N	1.3 – 132.8 mg/l NO_3	50-mm cell
range:	Expression of results also possible in mmol/l.		

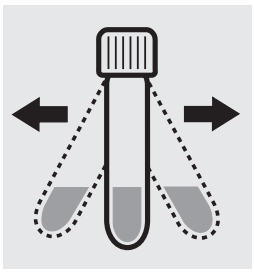


Check the pH of the sample, specified range: pH 3 – 9.
If required, add dilute sodium hydroxide solution or hydrochloric acid drop by drop to adjust the pH.



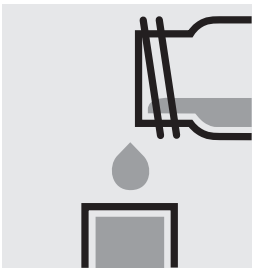
Pipette 10 ml of the sample into a test tube (Flat-bottomed tubes, Cat.No. 114902).

Add 1 level blue micro-spoon of **NO_3-1**, **immediately** close tightly with the screw cap.

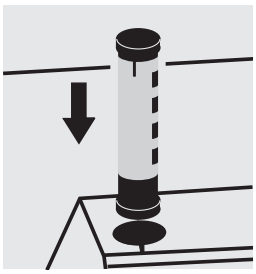


Shake the tube **vigorously for 1 minute** to dissolve the solid substance.

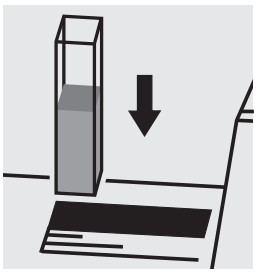
Reaction time:
5 minutes, **measure immediately**.



Transfer the solution (when possible without sediment) into a corresponding rectangular cell.



Select method with AutoSelector.



Place the cell into the cell compartment.

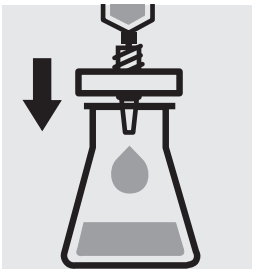
Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) a ready-for-use nitrate standard solution Certipur®, Cat.No. 119811, concentration 1000 mg/l NO_3^-, can be used after diluting accordingly.

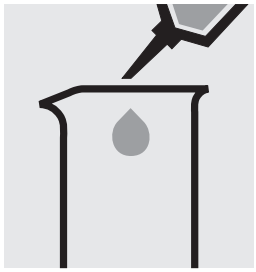
Nitrate
(Direct measurement in the UV range)
analogous to **APHA 4500-NO_3^- B**

Application

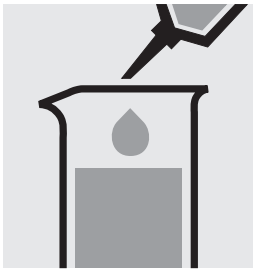
Measuring range: 0.0 – 7.0 mg/l NO_3-N 10-mm quartz cell



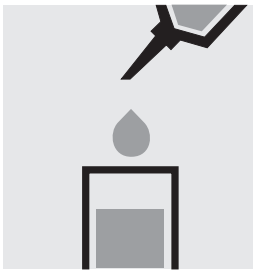
Filter turbid samples.



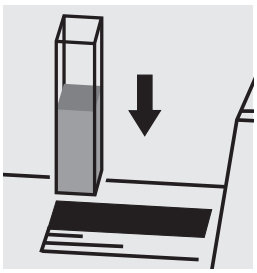
Place 50 ml of sample into a glass vessel.



Add 1 ml of **hydrochloric acid 1mol/l Titripur®** (Cat. No. 109057) with pipette and mix.



Transfer the solution into the quartz cell.



Place the cell into the cell compartment. Select method no. **2503**.

Important:

If “Condition not met” appears on the display, this is due to a sample-dependent interference (matrix effect).
In this case an evaluation is not possible.

Important:

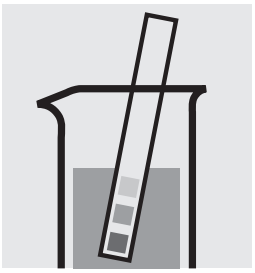
The exact procedure as well as further details on the method used can be found in the corresponding application. This application can be downloaded directly at www.analytical-test-kits.com.

Nitrite

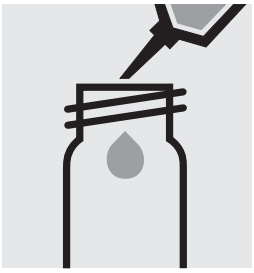
114547

Cell Test

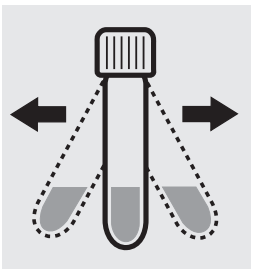
Measuring range:	0.010 – 0.700 mg/l NO_2-N
	0.03 – 2.30 mg/l NO_2
	Expression of results also possible in mmol/l.



Check the pH of the sample, specified range: pH 2 – 10.
If required, add dilute sulfuric acid drop by drop to adjust the pH.

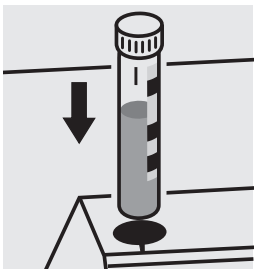


Pipette 5.0 ml of the sample into a reaction cell, close with the screw cap.



Shake the cell vigorously to dissolve the solid substance.

Reaction time: 10 minutes



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

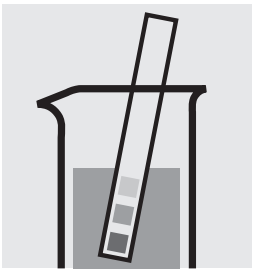
To check the measurement system (test reagents, measurement device, and handling) ready-for-use nitrite standard solution Certipur®, Cat.No. 119899, concentration 1000 mg/l NO_2^-, can be used after diluting accordingly as well as the Standard solution for photometric applications, CRM, Cat.No. 125041.

Nitrite

100609

Cell Test

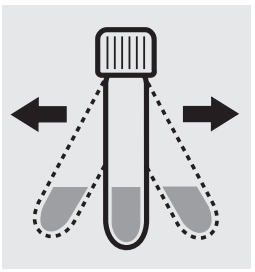
Measuring range:	1.0 – 90.0 mg/l NO_2-N 3 – 296 mg/l NO_2 Expression of results also possible in mmol/l.



Check the pH of the sample, specified range: pH 1 – 12.
If required, add dilute sulfuric acid drop by drop to adjust the pH.

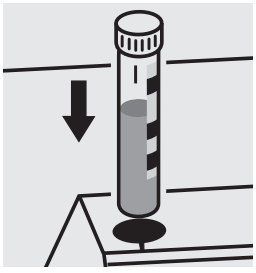
Add 2 level blue microspoons of **NO_2-1K** into a reaction cell.

Add 8.0 ml of the sample with pipette and close with the screw cap.



Shake the cell vigorously to dissolve the solid substance.

Reaction time:
20 minutes, **measure immediately**.
Do not shake or swirl the cell before the measurement.



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

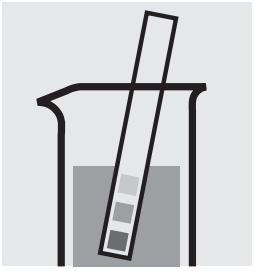
To check the measurement system (test reagents, measurement device, and handling) ready-for-use nitrite standard solution Certipur®, Cat.No. 119899, concentration 1000 mg/l NO_2^-, can be used after diluting accordingly as well as the Standard solution for photometric applications, CRM, Cat.No. 125042.

Nitrite

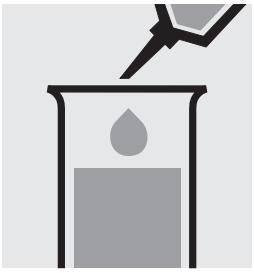
114776

Test

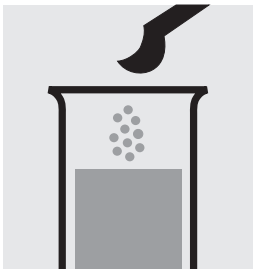
Measuring	0.02 – 1.00 mg/l NO_2-N	0.07 – 3.28 mg/l NO_2	10-mm cell
range:	0.010 – 0.500 mg/l NO_2-N	0.03 – 1.64 mg/l NO_2	20-mm cell
	0.002 – 0.200 mg/l NO_2-N	0.007 – 0.657 mg/l NO_2	50-mm cell
	Expression of results also possible in mmol/l.		



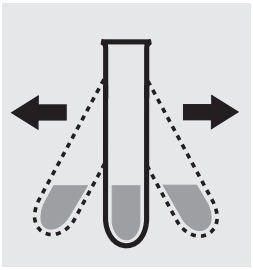
Check the pH of the sample, specified range: pH 2 – 10.
If required, add dilute sulfuric acid drop by drop to adjust the pH.



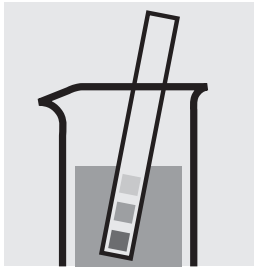
Pipette 5.0 ml of the sample into a test tube.



Add 1 level blue microspoon of **NO_2-1**.

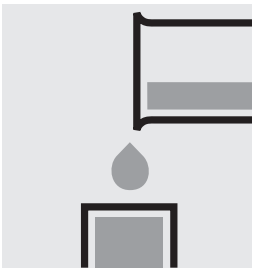


Shake vigorously to dissolve the solid substance.

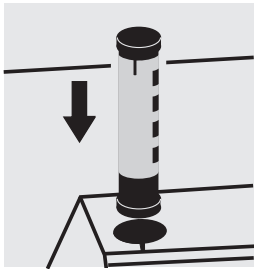


Check the pH, specified range: pH 2.0 – 2.5.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.

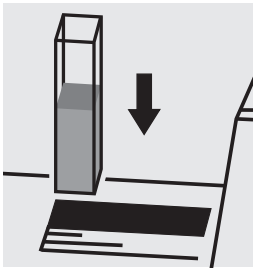
Reaction time:
10 minutes



Transfer the solution into a corresponding cell.



Select method with AutoSelector.



Place the cell into the cell compartment.

Important:

To measure in the 50-mm cell, the sample volume and the volume of the reagents have to be doubled for each. Alternatively, the semi-microcell, Cat.No. 173502, can be used.

Quality assurance:

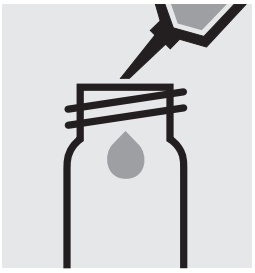
To check the measurement system (test reagents, measurement device, and handling) ready-for-use nitrite standard solution Certipur®, Cat.No. 119899, concentration 1000 mg/l NO_2^-, can be used after diluting accordingly as well as the Standard solution for photometric applications, CRM, Cat.No. 125041.

Nitrogen (total)

114537

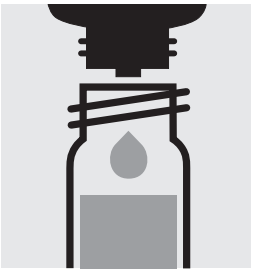
Cell Test

Measuring range:	0.5 – 15.0 mg/l N Expression of results also possible in mmol/l.

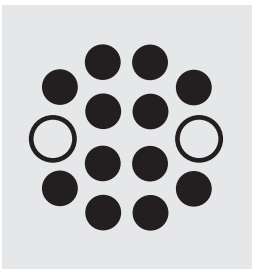


Pipette 10 ml of the sample into an empty round cell (Empty cells, Cat.No. 114724).

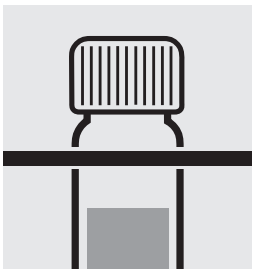
Add 1 level blue microspoon of **N-1K.**



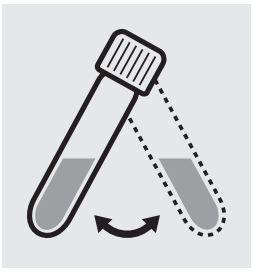
Add 6 drops of **N-2K**, close the cell with the screw cap, and mix.



Heat the cell in the thermoreactor at 120 °C (100 °C) for 1 hour.

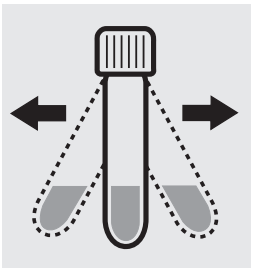


Remove the cell from the thermoreactor and place in a test-tube rack to cool to room temperature: **pretreated sample**.



Swirl the cell after 10 minutes.

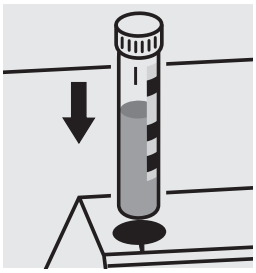
Add 1 level yellow microspoon of **N-3K into a reaction cell**, close the cell with the screw cap.



Shake the cell **vigorously for 1 minute** to dissolve the solid substance.

Add very slowly 1.5 ml of the **pretreated sample** with pipette, close the cell with the screw cap, and mix **briefly**.
Caution, cell becomes hot!

Reaction time: 10 minutes



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) we recommended to use Spectroquant® CombiCheck 50, Cat.No. 114695, or the Standard solution for photometric applications, CRM, Cat.No. 125043 and 125044.

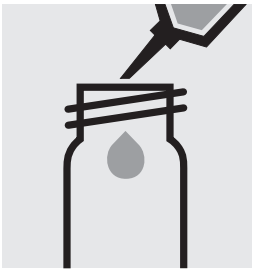
To check for sample-dependent effects the use of addition solutions (e.g. in CombiCheck 50) is highly recommended.

Nitrogen (total)

100613

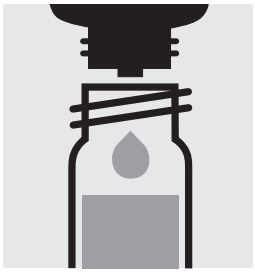
Cell Test

Measuring range:	0.5 – 15.0 mg/l N Expression of results also possible in mmol/l.

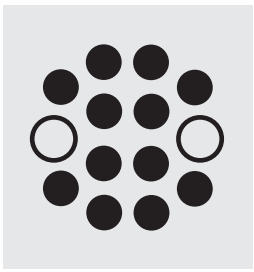


Pipette 10 ml of the sample into an empty round cell (Empty cells, Cat.No. 114724).

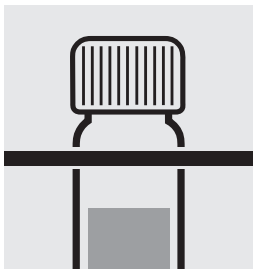
Add 1 level blue micro-spoon of **N-1K.**



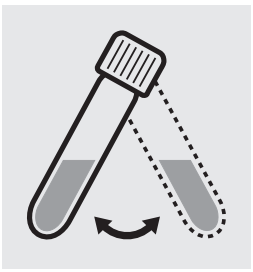
Add 6 drops of **N-2K**, close the cell with the screw cap, and mix.



Heat the cell in the thermoreactor at 120 °C (100 °C) for 1 hour.



Remove the cell from the thermoreactor and place in a test-tube rack to cool to room temperature: **pretreated sample**.

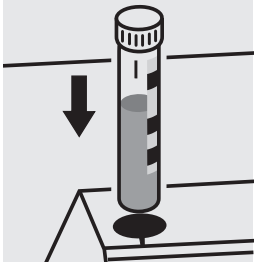


Swirl the cell after 10 minutes.

Pipette 1.0 ml of the **pretreated sample** into a reaction cell, **do not mix!**

Add 1.0 ml of **N-3K** with pipette, close the cell with the screw cap, and mix. **Caution, cell becomes hot!**

Reaction time: 10 minutes



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) we recommended to use Spectroquant® CombiCheck 50, Cat.No. 114695, or the Standard solution for photometric applications, CRM, Cat.No. 125043 and 125044.

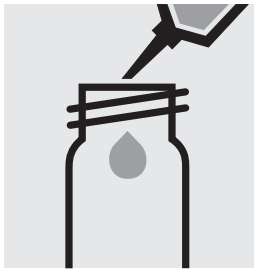
To check for sample-dependent effects the use of addition solutions (e.g. in CombiCheck 50) is highly recommended.

Nitrogen (total)

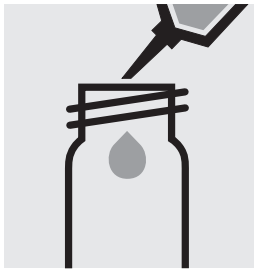
114763

Cell Test

Measuring range:	10 – 150 mg/l N Expression of results also possible in mmol/l.

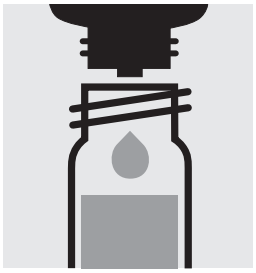


Pipette 1.0 ml of the sample into an empty round cell.

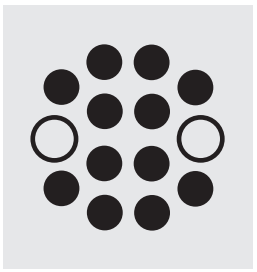


Add 9.0 ml of distilled water (Water for analysis EMSURE®, Cat.No. 116754, is recommended) with pipette.

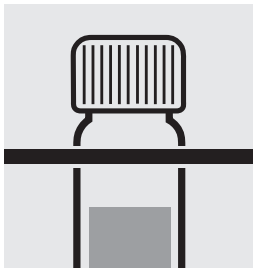
Add 1 level blue microspoon of **N-1K.**



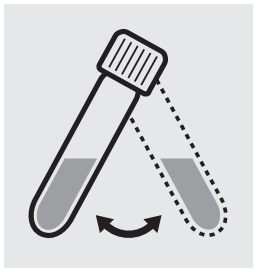
Add 6 drops of **N-2K**, close the cell with the screw cap, and mix.



Heat the cell in the thermoreactor at 120 °C (100 °C) for 1 hour.



Remove the cell from the thermoreactor and place in a test-tube rack to cool to room temperature: **pretreated sample**.

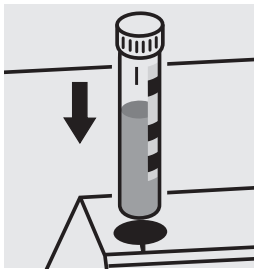


Swirl the cell after 10 minutes.

Pipette 1.0 ml of the **pretreated sample** into a reaction cell, **do not mix!**

Add 1.0 ml of **N-3K** with pipette, close the cell with the screw cap, and mix. **Caution, cell becomes hot!**

Reaction time: 10 minutes



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) we recommended to use Spectroquant® CombiCheck 70, Cat.No. 114689, or the Standard solution for photometric applications, CRM, Cat.No. 125044 and 125045.

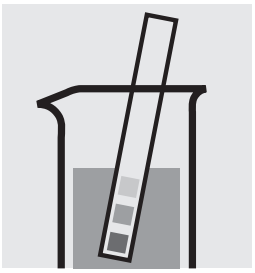
To check for sample-dependent effects the use of addition solutions (e.g. in CombiCheck 70) is highly recommended.

Oxygen

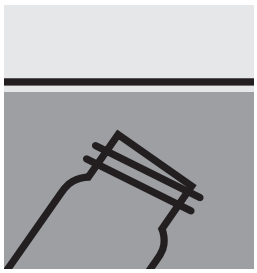
114694

Cell Test

Measuring range:	0.5 – 12.0 mg/l O_2 Expression of results also possible in mmol/l.



Check the pH of the sample, specified range: pH 6 – 8.
If required, add dilute sodium hydroxide solution or nitric acid drop by drop to adjust the pH.



Fill watersample into a reaction cell to over-flowing and make sure, that no air bubbles are present.

Place the filled cell in a test-tube rack.

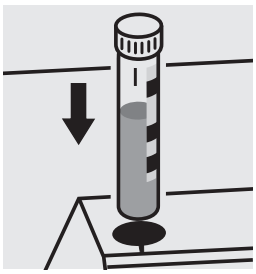
Add with microspoon 1 glass bead.

Add 5 drops of **O_2-1K.**

Add 5 drops of O_2-2K, close the cell with the screw cap, and shake for 10 seconds.

Reaction time:
1 minute

Add 10 drops of **O_2-3K**, close the cell with the screw cap, mix, and clean from outside.



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

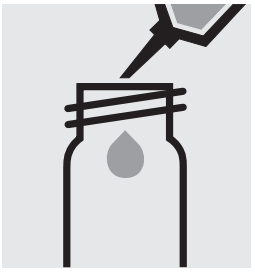
To check the measurement system (test reagents, measurement device, and handling) a oxygen standard solution must be prepared (application see the website).

Oxygen Scavengers

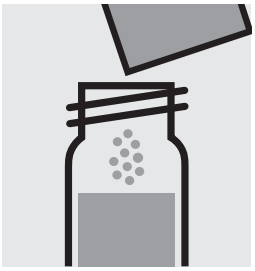
119251

Test

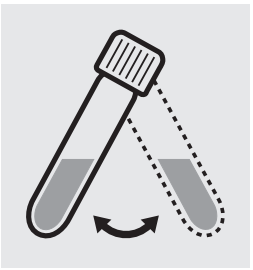
Measuring range:	0.020 – 0.500 mg/l DEHA*	20-mm cell
	* N,N-diethylenhydroxylamine	
	0.027 – 0.666 mg/l Carbohy*	20-mm cell
	* carbohydrazide	
	0.05 – 1.32 mg/l Hydro*	20-mm cell
	* hydroquinone	
	0.08 – 1.95 mg/l ISA*	20-mm cell
	* isoascorbic acid	
	0.09 – 2.17 mg/l MEKO*	20-mm cell
	* methylethylketoxime	



Pipette 10 ml of the sample into into a empty round cell (Empty cells, Cat.No. 114724).



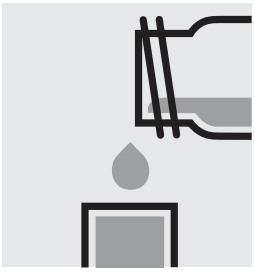
Add 1 powder pack of **Oxyscav 1** and close with the screw cap.



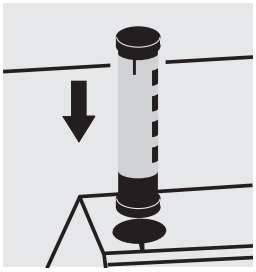
Swirl the cell to dissolve the solid substance.

Add 0.20 ml of **Oxyscav 2** with pipette, close with the screw cap, and mix.

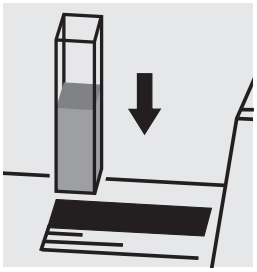
Reaction time: 10 minutes, **protect from light in the process**, **measure immediately**.



Transfer the solution into a rectangular cell.



Select method with AutoSelector.



Place the cell into the cell compartment.

Quality assurance:

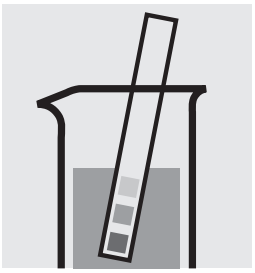
To check the measurement system (test reagents, measurement device, and handling) a oxygen scavengers standard solution must be prepared from N,N-diethylhydroxylamine, Cat.No. 818473 (see section “Standard solutions”).

Ozone

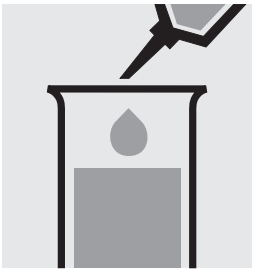
100607

Test

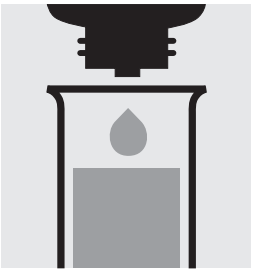
Measuring	0.05 – 4.00	mg/l O_3	10-mm cell
range:	0.02 – 2.00	mg/l O_3	20-mm cell
	0.010 – 0.800	mg/l O_3	50-mm cell
	Expression of results also possible in mmol/l.		



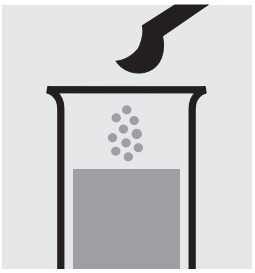
Check the pH of the sample, specified range: pH 4 – 8.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.



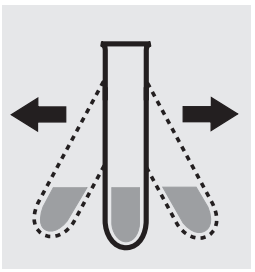
Pipette 10 ml of the sample into a test tube.



Add 2 drops of **O_3-1** and mix.

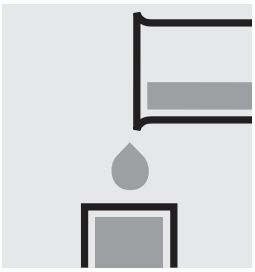


Add 1 level blue micro-spoon of **O_3-2.**

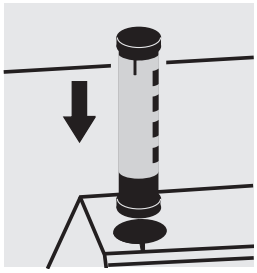


Shake vigorously to dissolve the solid substance.

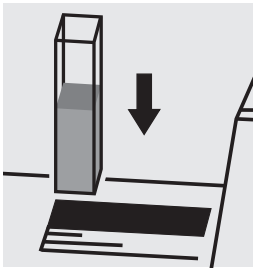
Reaction time:
1 minute



Transfer the solution into a corresponding cell.



Select method with AutoSelector.



Place the cell into the cell compartment.

Important:

Very high ozone concentrations in the sample produce yellow-colored solutions (measurement solution should be red) and false-low readings are yielded. In such cases the sample must be diluted (plausibility check).

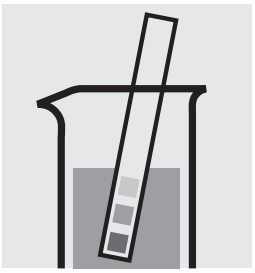
Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) a freshly prepared standard solution can be used (see section “Standard solutions”).

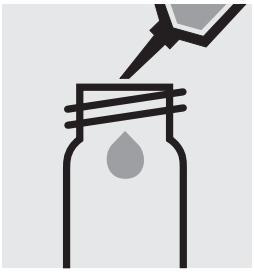
Palladium in water and wastewater

Application

Measuring range: 0.05 – 1.25 mg/l Pd 10-mm cell



Check the pH of the sample, specified range: pH 2 – 5.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.



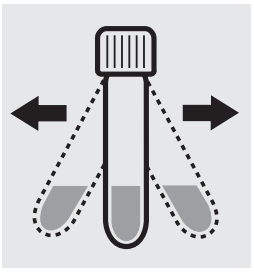
Pipette 5.0 ml of the sample into an empty round cell (Empty cells, Cat.No. 114724).

Add 1.0 ml of **reagent 1** with pipette, close the cell with the screw cap, and mix.

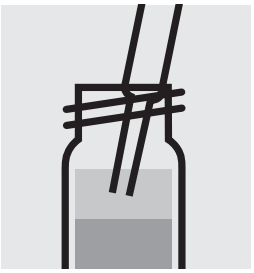
Check the pH of the sample, specified value: pH 3.0.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.

Add 0.20 ml of **reagent 2** with pipette, close the cell with the screw cap, and mix.

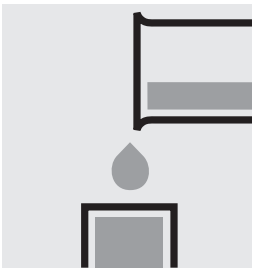
Add 5.0 ml **isoamyl alcohol GR** (Cat.No. 100979) with pipette, close the cell with the screw cap.



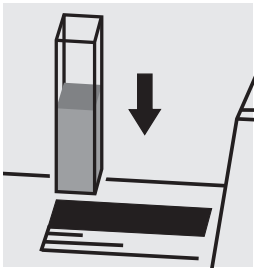
Shake the cell vigorously for 1 minute.
Leave to stand to allow phases to separate.



Aspirate the organic-clear upper phase from the tube with pipette and dry over **sodium sulfate anhydrous** (Cat.No. 106649).



Transfer the dried solution into a rectangular cell.



Place the cell into the cell compartment.
Select method no. **133**.

Note:

Empty cells with screw caps, Cat.No. 114724 are recommended for the preparation. These cells can be sealed with the screw caps, thus enabling a hazard-free mixing of the sample.

Important:

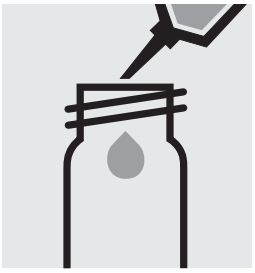
The exact composition and preparation of the reagents 1 and 2 used are given in the corresponding application, which also includes further information on the method employed. This application can be downloaded directly at www.analytical-test-kits.com.

pH

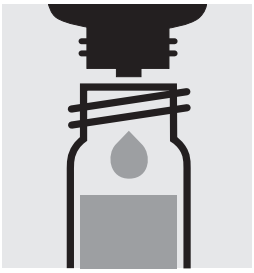
101744

Cell Test

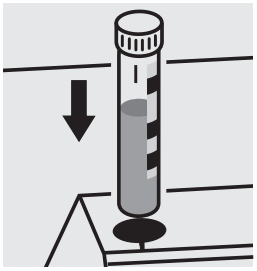
Measuring range: pH 6.4 – 8.8



Pipette 10 ml of the sample into a round cell.



Add 4 drops of **pH-1**, close the cell with the screw cap, and mix.
Attention!
The reagent bottle must be held **vertically by all means!**



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

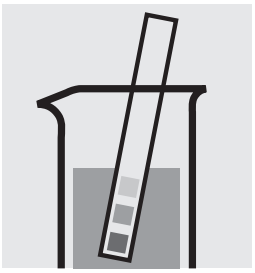
To check the measurement system (test reagents, measurement device, and handling) buffer solution pH 7.00 Certipur®, Cat.No. 109407, can be used.

Phenol

114551

Cell Test

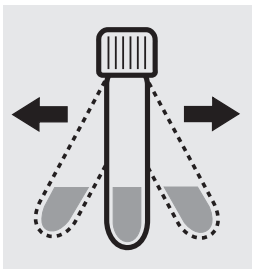
Measuring range:	0.10 – 2.50 mg/l phenol Expression of results also possible in mmol/l.



Check the pH of the sample, specified range: pH 2 – 11.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.

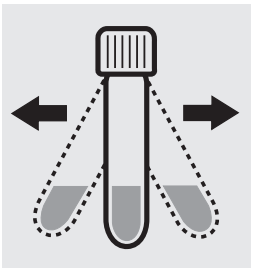
Pipette 10 ml of the sample into a reaction cell, close with the screw cap, and mix.

Add 1 level grey micro-spoon of **Ph-1K**, close the cell with the screw cap.



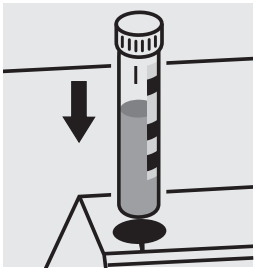
Shake the cell vigorously to dissolve the solid substance.

Add 1 level green micro-spoon of **Ph-2K**, close the cell with the screw cap.



Shake the cell vigorously to dissolve the solid substance.

Reaction time:
1 minute



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Important:

Very high phenol concentrations in the sample result in a weakening of the color and false-low readings are yielded. In such cases the sample must be diluted (plausibility check).

Quality assurance:

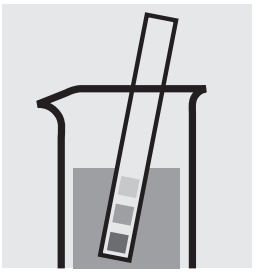
To check the measurement system (test reagents, measurement device, and handling) a phenol standard solution must be prepared from Phenol GR, Cat.No. 100206 (see section “Standard solutions”).

Phenol

100856

Test

Measuring range:	0.002 – 0.100 mg/l C_6H_5OH 20-mm cell Expression of results also possible in mmol/l.
Attention!	The measurement is carried out in a 20-mm rectangular cell against a blank, prepared from distilled water (Water for analysis EMSURE®, Cat.No. 116754, is recommended) and the reagents in an analogous manner.



Check the pH of the sample, specified range: pH 2 – 11.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.

Pipette 200 ml of sample into a separation funnel.

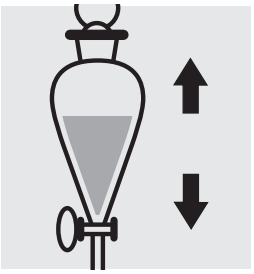
Add 5.0 ml of **Ph-1** with pipette and mix.

Add 1 level green microspoon of **Ph-2** and shake to dissolve the solid substance.

Add 1 level green microspoon of **Ph-3** and shake to dissolve the solid substance.

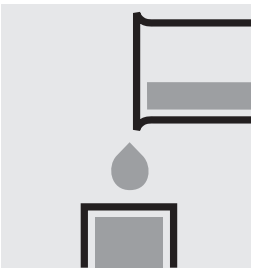
Reaction time:
30 minutes
(protected from light)

Add 10 ml of chloroform with pipette, close separation funnel.

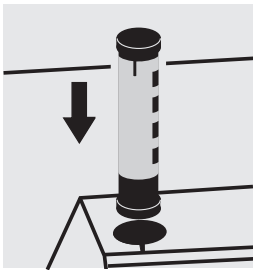


Shake vigorously for 1 minute.

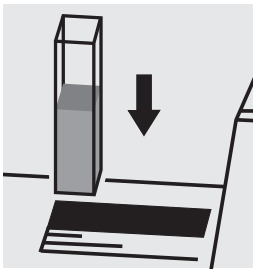
Leave to stand for 5 – 10 minutes to allow the phases to separate.



Transfer the clear **lower** phase into a cell.



Select method with AutoSelector measuring range 0.002 – 0.100 mg/l.



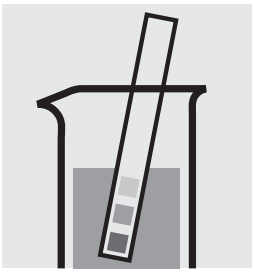
Place the cell into the cell compartment.

Phenol

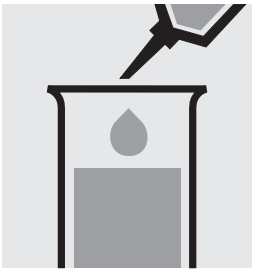
100856

Test

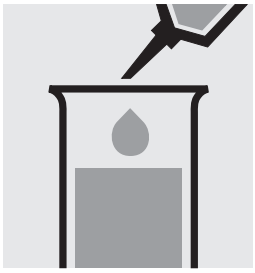
Measuring range:	0.10 – 5.00 mg/l C_6H_5OH	10-mm cell
	0.05 – 2.50 mg/l C_6H_5OH	20-mm cell
	0.025 – 1.000 mg/l C_6H_5OH	50-mm cell
	Expression of results also possible in mmol/l.	



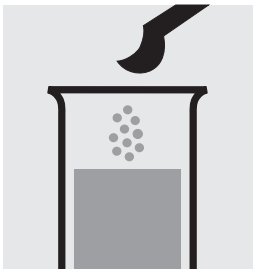
Check the pH of the sample, specified range: pH 2 – 11.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.



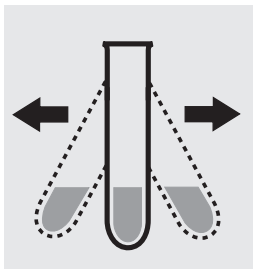
Pipette 10 ml of the sample into a test tube.



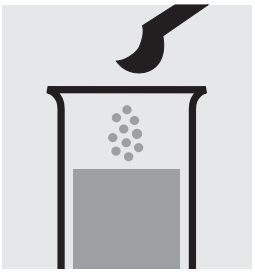
Add 1.0 ml of **Ph-1** with pipette and mix.



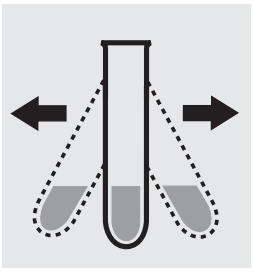
Add 1 level grey microspoon of **Ph-2**.



Shake vigorously to dissolve the solid substance.

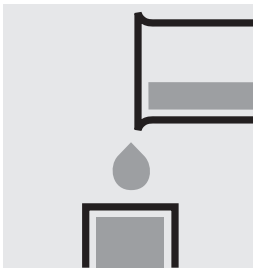


Add 1 level grey microspoon of **Ph-3**.

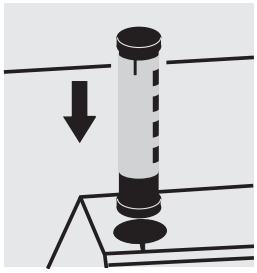


Shake vigorously to dissolve the solid substance.

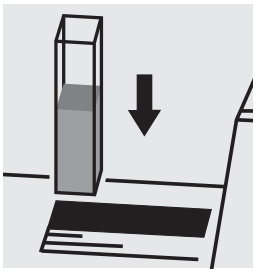
Reaction time: 10 minutes



Transfer the solution into a corresponding cell.



Select method with AutoSelector measuring range 0.025 – 5.00 mg/l.



Place the cell into the cell compartment.

Important:

For the determination of **total phosphorus = sum of orthophosphate, polyphosphate and organophosphate** either Phosphate Cell Test, Cat. No. 114543, 114729, and 100673 or Phosphate Test, Cat. No. 114848 in conjunction with Crack Set 10/10C, Cat. No. 114687 resp. 114688 can be used.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) a phenole standard solution must be prepared from Phenol GR, Cat.No. 100206 (see section “Standard solutions”).

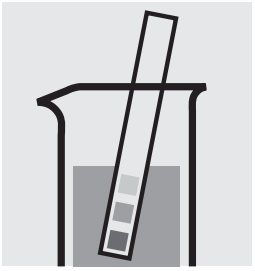
Phosphate

Determination of orthophosphate

100474

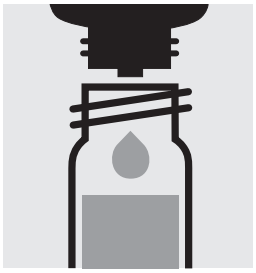
Cell Test

Measuring range:	0.05 – 5.00 mg/l PO_4 -P
	0.2 – 15.3 mg/l PO_4
	0.11 – 11.46 mg/l P_2O_5
	Expression of results also possible in mmol/l.

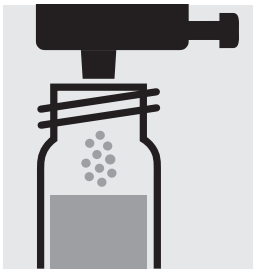


Check the pH of the sample, specified range: pH 0 – 10.
If required, add dilute sulfuric acid drop by drop to adjust the pH.

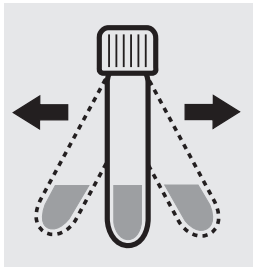
Pipette 5.0 ml of the sample into a reaction cell, close with the screw cap, and mix.



Add 5 drops of **P-1K**, close the cell with the screw cap, and mix.

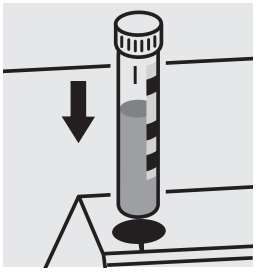


Add 1 dose of **P-2K** using the blue dose-metering cap, close the cell with the screw cap.



Shake the cell vigorously to dissolve the solid substance.

Reaction time:
5 minutes



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) we recommended to use Spectroquant® CombiCheck 10, Cat.No. 114676.

Ready-for-use phosphate standard solution Certipur®, Cat.No. 119898, concentration 1000 mg/l PO_4^{3-}, can also be used after diluting accordingly.

To check for sample-dependent effects the use of addition solutions (e.g. in CombiCheck 10) is highly recommended.

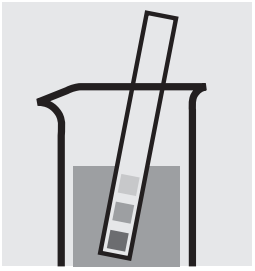
Phosphate

114543

Determination of orthophosphate

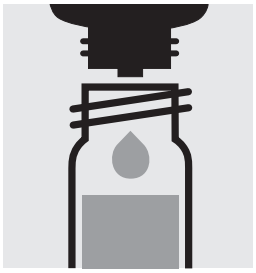
Cell Test

Measuring range:	0.05 – 5.00 mg/l PO_4 -P
	0.2 – 15.3 mg/l PO_4
	0.11 – 11.46 mg/l P_2O_5
	Expression of results also possible in mmol/l.

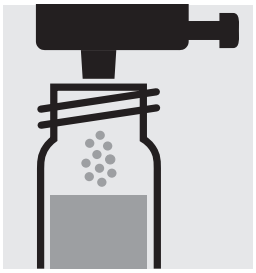


Check the pH of the sample, specified range: pH 0 – 10.
If required, add dilute sulfuric acid drop by drop to adjust the pH.

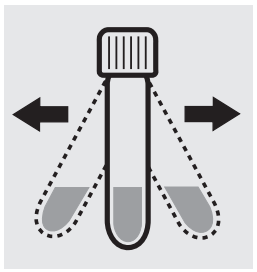
Pipette 5.0 ml of the sample into a reaction cell, close with the screw cap, and mix.



Add 5 drops of **P-2K**, close the cell with the screw cap, and mix.

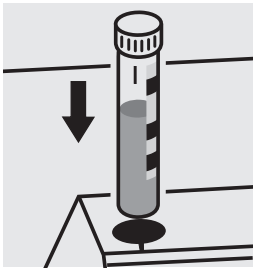


Add 1 dose of **P-3K** using the blue dose-metering cap, close the cell with the screw cap.



Shake the cell vigorously to dissolve the solid substance.

Reaction time:
5 minutes



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) we recommended to use Spectroquant® CombiCheck 10, Cat.No. 114676.

Ready-for-use phosphate standard solution Certipur®, Cat.No. 119898, concentration 1000 mg/l PO_4^{3-}, can also be used after diluting accordingly.

To check for sample-dependent effects the use of addition solutions (e.g. in CombiCheck 10) is highly recommended.

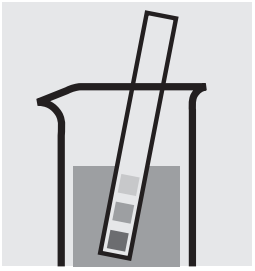
Phosphate

Determination of total phosphorus
= sum of orthophosphate, polyphosphate, and organophosphate

114543

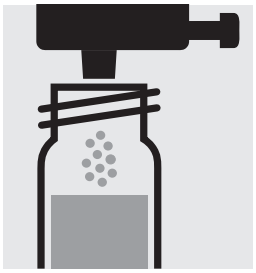
Cell Test

Measuring range:	0.05 – 5.00 mg/l P
	0.2 – 15.3 mg/l PO_4
	0.11 – 11.46 mg/l P_2O_5
	Expression of results also possible in mmol/l and also in P total (Σ P) and P org* [P(o)].

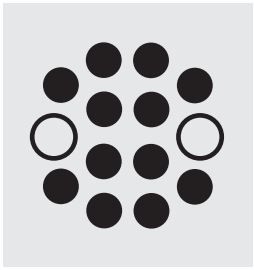


Check the pH of the sample, specified range: pH 0 – 10.
If required, add dilute sulfuric acid drop by drop to adjust the pH.

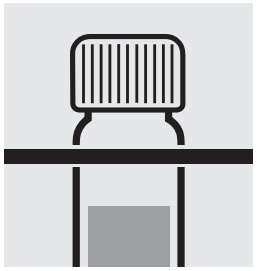
Pipette 5.0 ml of the sample into a reaction cell, close with the screw cap, and mix.



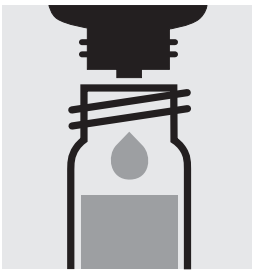
Add 1 dose of **P-1K** using the green dose-metering cap, close the cell with the screw cap.



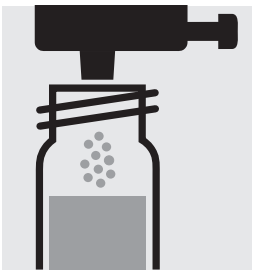
Heat the cell in the thermoreactor at 120 °C (100 °C) for 30 minutes.



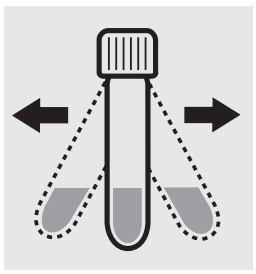
Remove the cell from the thermoreactor and place in a test-tube rack to cool to room temperature.



Add 5 drops of **P-2K**, close the cell with the screw cap, and mix.

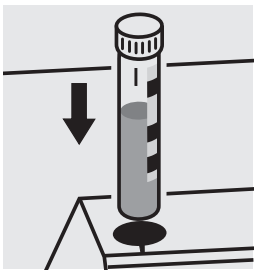


Add 1 dose of **P-3K** using the blue dose-metering cap, close the cell with the screw cap.



Shake the cell vigorously to dissolve the solid substance.

Reaction time:
5 minutes



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

A differentiation between orthophosphate (PO_4-P) and P org* (P(o)) can be performed on the photometer. Prior to measuring, select the differentiation measurement and choose the corresponding citation form. Then measure the P total (result for "P total" is shown on the display), press enter and measure the ortho-phosphate (see analytical procedure for ortho-phosphate). The individual measuring values for PO_4-P and P(o) are shown on the display.

* P org is the sum of polyphosphate and organophosphate.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) we recommended to use Spectroquant® CombiCheck 10, Cat.No. 114676, or the Standard solution for photometric applications, CRM, Cat.No. 125046 and 125047.

Ready-for-use phosphate standard solution Certipur®, Cat.No. 119898, concentration 1000 mg/l PO_4^{3-}, can also be used after diluting accordingly.

To check for sample-dependent effects the use of addition solutions (e.g. in CombiCheck 10) is highly recommended.

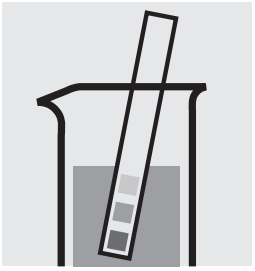
Phosphate

100475

Determination of orthophosphate

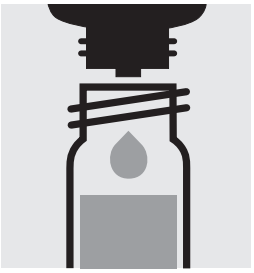
Cell Test

Measuring range:	0.5 – 25.0 mg/l PO_4 -P
	1.5 – 76.7 mg/l PO_4
	1.1 – 57.3 mg/l P_2O_5
	Expression of results also possible in mmol/l.

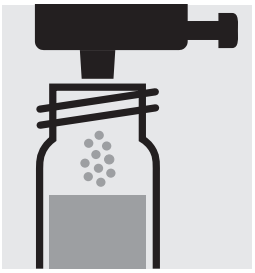


Check the pH of the sample, specified range: pH 0 – 10.
If required, add dilute sulfuric acid drop by drop to adjust the pH.

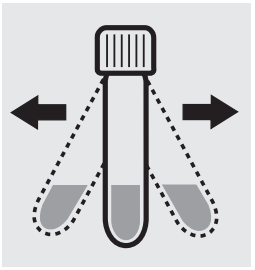
Pipette 1.0 ml of the sample into a reaction cell, close with the screw cap, and mix.



Add 5 drops of **P-1K**, close the cell with the screw cap, and mix.

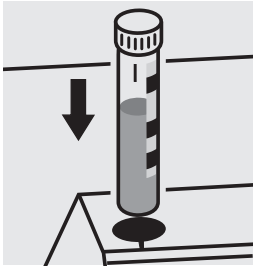


Add 1 dose of **P-2K** using the blue dose-metering cap, close the cell with the screw cap.



Shake the cell vigorously to dissolve the solid substance.

Reaction time:
5 minutes



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Important:

For the determination of **total phosphorus = sum of orthophosphate, polyphosphate and organophosphate** either Phosphate Cell Test, Cat. No. 114543, 114729, and 100673 or Phosphate Test, Cat. No. 114848 in conjunction with Crack Set 10/10C, Cat. No. 114687 resp. 114688 can be used.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) we recommended to use Spectroquant® CombiCheck 20 and 80, Cat.No. 114675 and 114738.

Ready-for-use phosphate standard solution Certipur®, Cat.No. 119898, concentration 1000 mg/l PO_4^{3-}, can also be used after diluting accordingly.

To check for sample-dependent effects the use of addition solutions (e.g. in CombiCheck) is highly recommended.

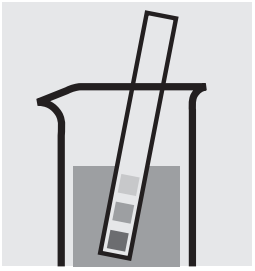
Phosphate

114729

Determination of orthophosphate

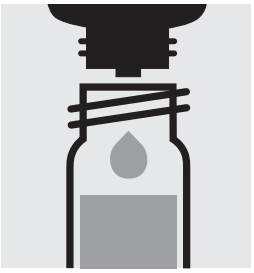
Cell Test

Measuring range:	0.5 – 25.0 mg/l PO_4 -P
	1.5 – 76.7 mg/l PO_4
	1.1 – 57.3 mg/l P_2O_5
	Expression of results also possible in mmol/l.

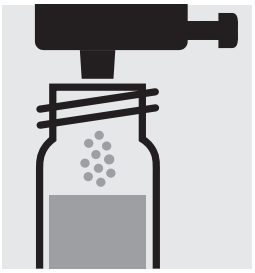


Check the pH of the sample, specified range: pH 0 – 10.
If required, add dilute sulfuric acid drop by drop to adjust the pH.

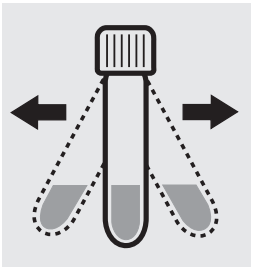
Pipette 1.0 ml of the sample into a reaction cell, close with the screw cap, and mix.



Add 5 drops of **P-2K**, close the cell with the screw cap, and mix.

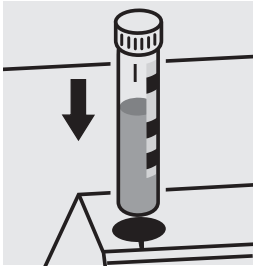


Add 1 dose of **P-3K** using the blue dose-metering cap, close the cell with the screw cap.



Shake the cell vigorously to dissolve the solid substance.

Reaction time:
5 minutes



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) we recommended to use Spectroquant® CombiCheck 20 and 80, Cat.No. 114675 and 114738.

Ready-for-use phosphate standard solution Certipur®, Cat.No. 119898, concentration 1000 mg/l PO_4^{3-}, can also be used after diluting accordingly.

To check for sample-dependent effects the use of addition solutions (e.g. in CombiCheck) is highly recommended.

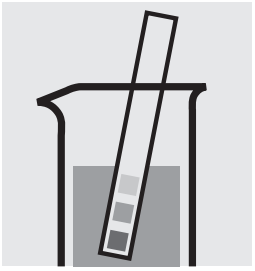
Phosphate

Determination of total phosphorus
= sum of orthophosphate, polyphosphate, and organophosphate

114729

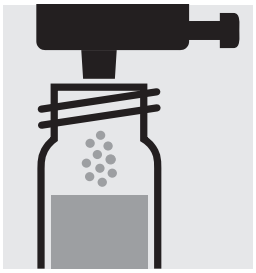
Cell Test

Measuring range:	0.5 – 25.0 mg/l P
	1.5 – 76.7 mg/l PO_4
	1.1 – 57.3 mg/l P_2O_5
	Expression of results also possible in mmol/l and also in P total (Σ P) and P org* [P(o)].

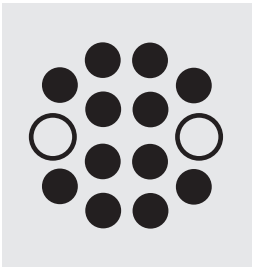


Check the pH of the sample, specified range: pH 0 – 10.
If required, add dilute sulfuric acid drop by drop to adjust the pH.

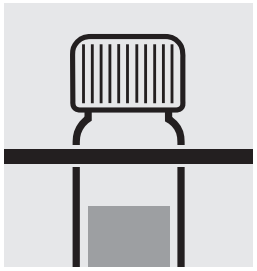
Pipette 1.0 ml of the sample into a reaction cell, close with the screw cap, and mix.



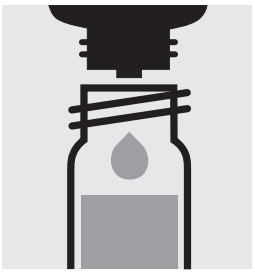
Add 1 dose of **P-1K** using the green dose-metering cap, close the cell with the screw cap.



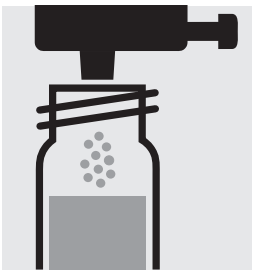
Heat the cell in the thermoreactor at 120 °C (100 °C) for 30 minutes.



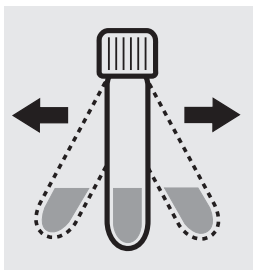
Remove the cell from the thermoreactor and place in a test-tube rack to cool to room temperature.



Add 5 drops of **P-2K**, close the cell with the screw cap, and mix.

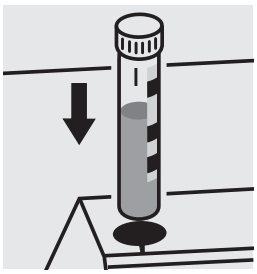


Add 1 dose of **P-3K** using the blue dose-metering cap, close the cell with the screw cap.



Shake the cell vigorously to dissolve the solid substance.

Reaction time:
5 minutes



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

A differentiation between orthophosphate (PO_4-P) and P org* (P(o)) can be performed on the photometer. Prior to measuring, select the differentiation measurement and choose the corresponding citation form. Then measure the P total (result for "P total" is shown on the display), press enter and measure the ortho-phosphate (see analytical procedure for ortho-phosphate). The individual measuring values for PO_4-P and P(o) are shown on the display.

* P org is the sum of polyphosphate and organophosphate.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) we recommended to use Spectroquant® CombiCheck 20 and 80, Cat.No. 114675 and 114738, or as well as the Standard solution for photometric applications, CRM, Cat.No. 125047 and 125048.

Ready-for-use phosphate standard solution Certipur®, Cat.No. 119898, concentration 1000 mg/l PO_4^{3-}, can also be used after diluting accordingly.

To check for sample-dependent effects the use of addition solutions (e.g. in CombiCheck) is highly recommended.

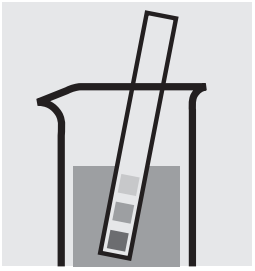
Phosphate

Determination of orthophosphate

100616

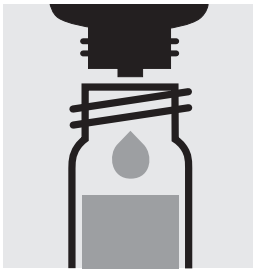
Cell Test

Measuring range:	3.0 – 100.0	mg/l PO_4 -P
	9 – 307	mg/l PO_4
	7 – 229	mg/l P_2O_5
	Expression of results also possible in mmol/l.	

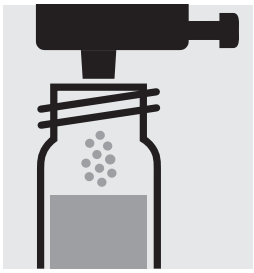


Check the pH of the sample, specified range: pH 0 – 10.
If required, add dilute sulfuric acid drop by drop to adjust the pH.

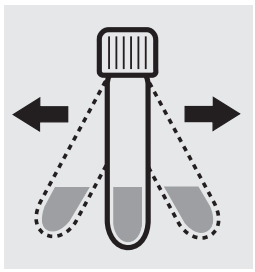
Pipette 0.20 ml of the sample into a reaction cell, close with the screw cap, and mix.



Add 5 drops of **PO_4-1K**, close the cell with the screw cap, and mix.

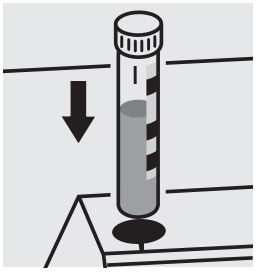


Add 1 dose of **PO_4-2K** using the blue dose-metering cap, close the cell with the screw cap.



Shake the cell vigorously to dissolve the solid substance.

Reaction time:
5 minutes



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Important:

For the determination of **total phosphorus = sum of orthophosphate, polyphosphate and organophosphate** either Phosphate Cell Test, Cat. No. 114543, 114729, and 100673 or Phosphate Test, Cat. No. 114848 in conjunction with Crack Set 10/10C, Cat. No. 114687 resp. 114688 can be used.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) ready-for-use phosphate standard solution Certipur®, Cat.No. 119898, concentration 1000 mg/l PO_4^{3-}, can be used after diluting accordingly.

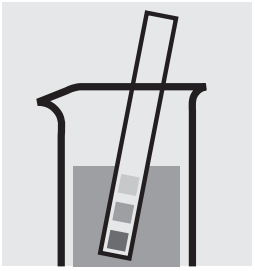
Phosphate

Determination of orthophosphate

100673

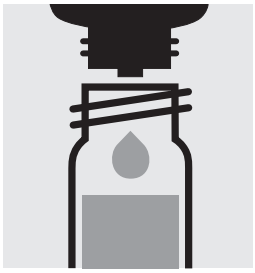
Cell Test

Measuring	3.0 – 100.0	mg/l PO_4 -P
range:	9 – 307	mg/l PO_4
	7 – 229	mg/l P_2O_5
	Expression of results also possible in mmol/l.	

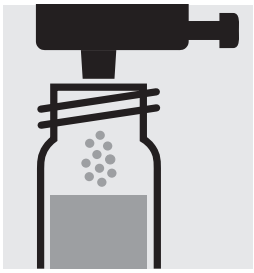


Check the pH of the sample, specified range: pH 0 – 10.
If required, add dilute sulfuric acid drop by drop to adjust the pH.

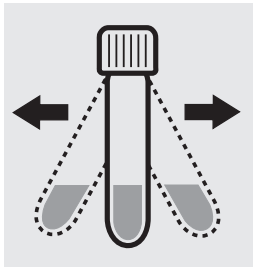
Pipette 0.20 ml of the sample into a reaction cell, close with the screw cap, and mix.



Add 5 drops of **P-2K**, close the cell with the screw cap, and mix.

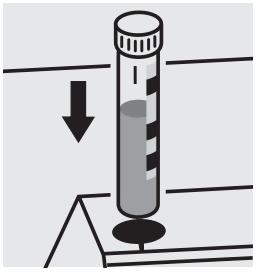


Add 1 dose of **P-3K** using the blue dose-metering cap, close the cell with the screw cap.



Shake the cell vigorously to dissolve the solid substance.

Reaction time:
5 minutes



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) ready-for-use phosphate standard solution Certipur®, Cat.No. 119898, concentration 1000 mg/l PO_4^{3-}, can be used after diluting accordingly.

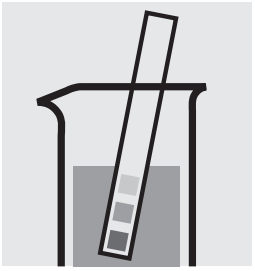
Phosphate

Determination of total phosphorus
= sum of orthophosphate, polyphosphate, and organophosphate

100673

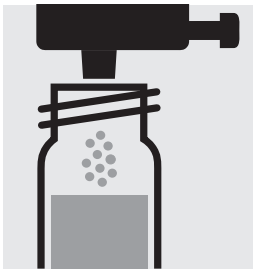
Cell Test

Measuring range:	3.0 – 100.0 mg/l PO_4 -P
	9 – 307 mg/l PO_4
	7 – 229 mg/l P_2O_5
	Expression of results also possible in mmol/l and also in P total (Σ P) and P org* [P(o)].

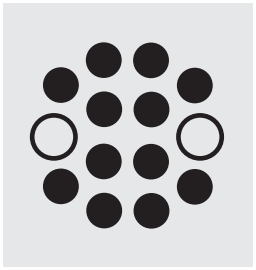


Check the pH of the sample, specified range: pH 0 – 10.
If required, add dilute sulfuric acid drop by drop to adjust the pH.

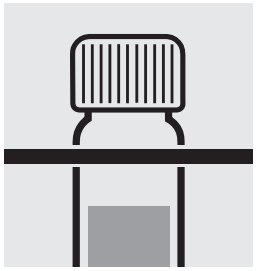
Pipette 0.20 ml of the sample into a reaction cell, close with the screw cap, and mix.



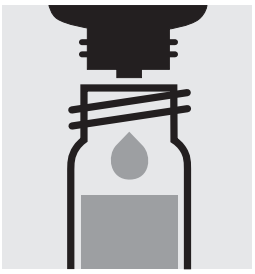
Add 1 dose of **P-1K** using the green dose-metering cap, close the cell with the screw cap.



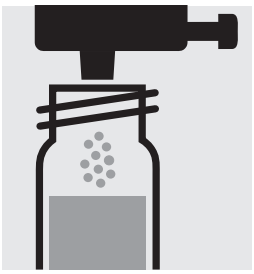
Heat the cell in the thermoreactor at 120 °C (100 °C) for 30 minutes.



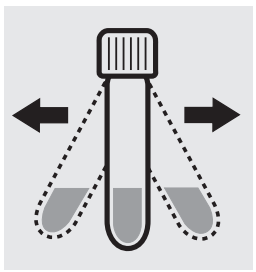
Remove the cell from the thermoreactor and place in a test-tube rack to cool to room temperature.



Add 5 drops of **P-2K**, close the cell with the screw cap, and mix.

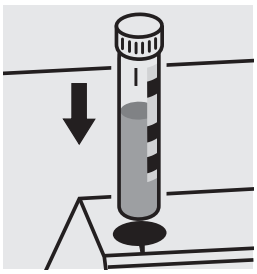


Add 1 dose of **P-3K** using the blue dose-metering cap, close the cell with the screw cap.



Shake the cell vigorously to dissolve the solid substance.

Reaction time:
5 minutes



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

A differentiation between orthophosphate (PO_4-P) and P org* (P(o)) can be performed on the photometer. Prior to measuring, select the differentiation measurement and choose the corresponding citation form. Then measure the P total (result for "P total" is shown on the display), press enter and measure the ortho-phosphate (see analytical procedure for ortho-phosphate). The individual measuring values for PO_4-P and P(o) are shown on the display.

* P org is the sum of polyphosphate and organophosphate.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) ready-for-use phosphate standard solution Certipur®, Cat.No. 119898, concentration 1000 mg/l PO_4^{3-}, can be used after diluting accordingly as well as the Standard solution for photometric applications, CRM, Cat.No. 125047, 125048, and 125049.

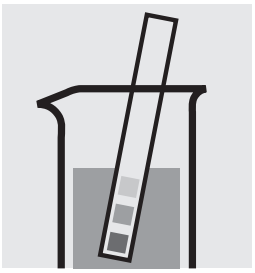
Phosphate

Determination of orthophosphate

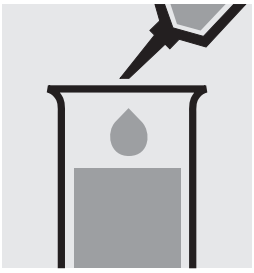
114848

Test

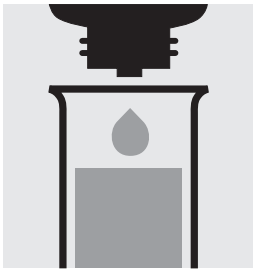
Measuring	0.05 – 5.00 mg/l PO_4-P	0.2 – 15.3 mg/l PO_4	0.11 – 11.46 mg/l P_2O_5	10-mm cell
range:	0.03 – 2.50 mg/l PO_4-P	0.09 – 7.67 mg/l PO_4	0.07 – 5.73 mg/l P_2O_5	20-mm cell
	0.010 – 1.000 mg/l PO_4-P	0.03 – 3.07 mg/l PO_4	0.02 – 2.29 mg/l P_2O_5	50-mm cell
	Expression of results also possible in mmol/l.			



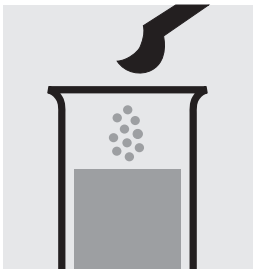
Check the pH of the sample, specified range: pH 0 – 10.
If required, add dilute sulfuric acid drop by drop to adjust the pH.



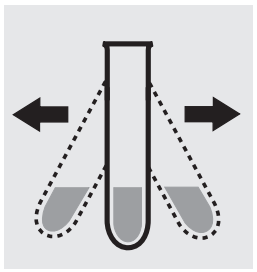
Pipette 5.0 ml of the sample into a test tube.



Add 5 drops of **PO_4-1** and mix.

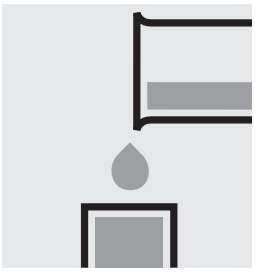


Add 1 level blue micro-spoon of **PO_4-2**.

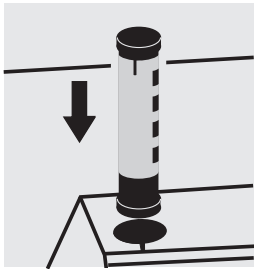


Shake vigorously to dissolve the solid substance.

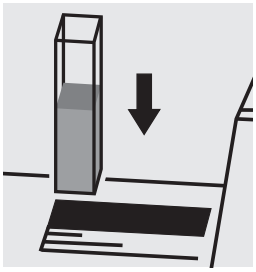
Reaction time:
5 minutes



Transfer the solution into a corresponding cell.



Select method with AutoSelector.



Place the cell into the cell compartment.

Important:

For measurement in the 50-mm cell, the sample volume and the volume of the reagents have to be doubled for each.
Alternatively, the semi-microcell, Cat.No. 173502, can be used.

For the determination of **total phosphorus = sum of orthophosphate, polyphosphate, and organophosphate** a pretreatment with Crack Set 10C, Cat.No. 114688, or Crack Set 10, Cat.No. 114687, and thermoreactor is necessary.

Result can be expressed as sum of phosphorus (Σ P).

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) we recommended to use Spectroquant® CombiCheck 10, Cat.No. 114676. The data for the measurement in the 50-mm rectangular cell are already programmed in the photometer.

Ready-for-use phosphate standard solution Certipur®, Cat.No. 119898, concentration 1000 mg/l PO_4^{3-}, can also be used after diluting accordingly.

To check for sample-dependent effects the use of addition solutions (e.g. in CombiCheck 10) is highly recommended.

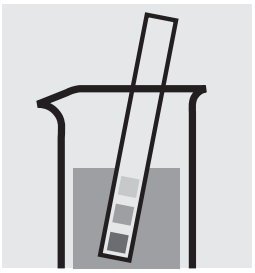
Phosphate

Determination of orthophosphate

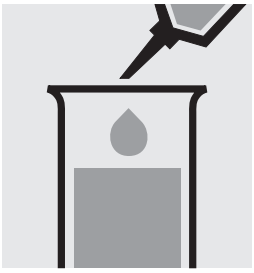
100798

Test

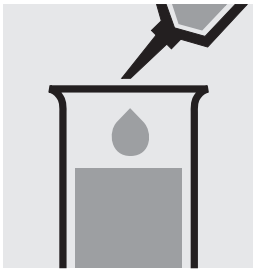
Measuring range:	1.0 – 100.0 mg/l PO_4-P	3 – 307	mg/l PO_4	2 – 229	mg/l P_2O_5	10-mm cell
	Expression of results also possible in mmol/l.					



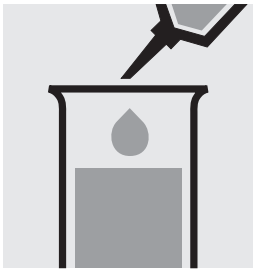
Check the pH of the sample, specified range: pH 0 – 10.
If required, add dilute sulfuric acid drop by drop to adjust the pH.



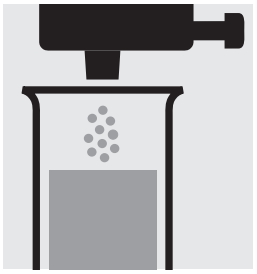
Pipette 8.0 ml of distilled water (Water for analysis EMSURE®, Cat.No. 116754, is recommended) into a test tube.



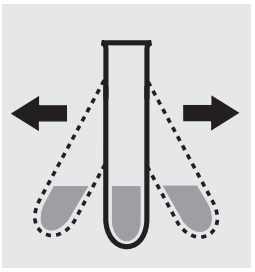
Add 0.50 ml of the sample with pipette and mix.



Add 0.50 ml of **PO_4-1** with pipette and mix.

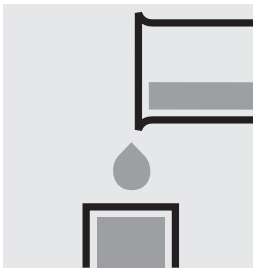


Add 1 dose of **PO_4-2** using the blue dose-metering cap.

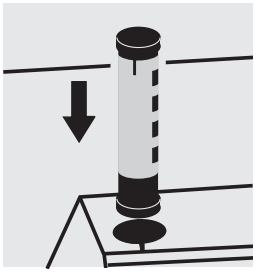


Shake vigorously to dissolve the solid substance.

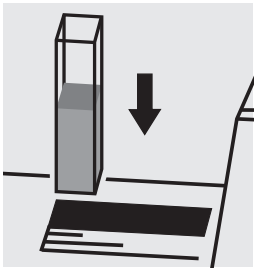
Reaction time:
5 minutes



Transfer the solution into a cell.



Select method with AutoSelector.



Place the cell into the cell compartment.

Important:

For the determination of **total phosphorus = sum of orthophosphate, polyphosphate and organophosphate** either Phosphate Cell Test, Cat. No. 114543, 114729, and 100673 or Phosphate Test, Cat. No. 114848 in conjunction with Crack Set 10/10C, Cat. No. 114687 resp. 114688 can be used.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) ready-for-use phosphate standard solution Certipur®, Cat.No. 119898, concentration 1000 mg/l PO_4^{3-}, can be used after diluting accordingly.

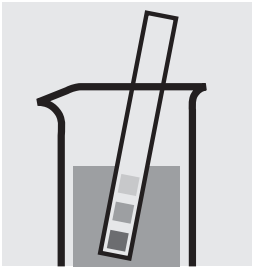
Phosphate

Determination of orthophosphate

114546

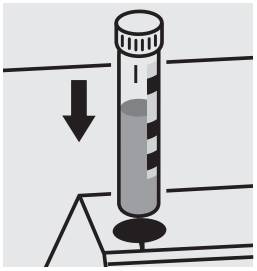
Cell Test

Measuring range:	0.5 – 25.0 mg/l PO_4-P
	1.5 – 76.7 mg/l PO_4
	1.1 – 57.3 mg/l P_2O_5
	Expression of results also possible in mmol/l.



Check the pH of the sample, specified range: pH 0 – 10.
If required, add dilute sulfuric acid drop by drop to adjust the pH.

Pipette 5.0 ml of the sample into a reaction cell, close with the screw cap, and mix.



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Important:

For the determination of **total phosphorus = sum of orthophosphate, polyphosphate and organophosphate** either Phosphate Cell Test, Cat. No. 114543, 114729, and 100673 or Phosphate Test, Cat. No. 114848 in conjunction with Crack Set 10/10C, Cat. No. 114687 resp. 114688 can be used.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) ready-for-use phosphate standard solution Certipur®, Cat.No. 119898, concentration 1000 mg/l PO_4^{3-}, can be used after diluting accordingly.

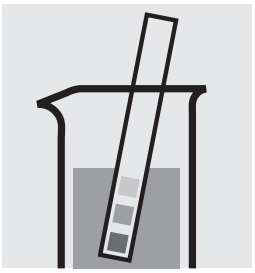
Phosphate

Determination of orthophosphate

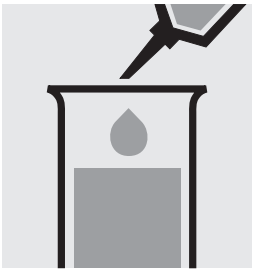
114842

Test

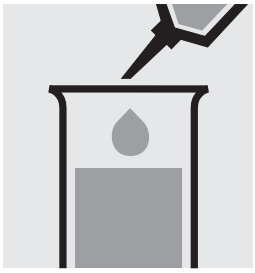
Measuring	1.0 – 30.0 mg/l PO_4-P	3.1 – 92.0 mg/l PO_4	2.3 – 68.7 mg/l P_2O_5	10-mm cell
range:	0.5 – 15.0 mg/l PO_4-P	1.5 – 46.0 mg/l PO_4	1.1 – 34.4 mg/l P_2O_5	20-mm cell
	Expression of results also possible in mmol/l.			



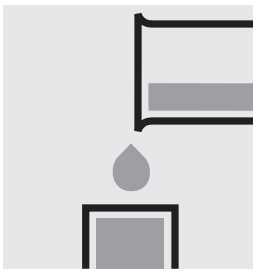
Check the pH of the sample, specified range: pH 0 – 10.
If required, add dilute sulfuric acid drop by drop to adjust the pH.



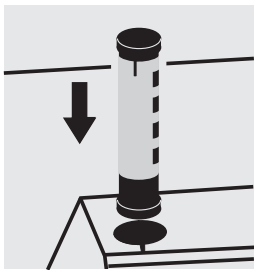
Pipette 5.0 ml of the sample into a test tube.



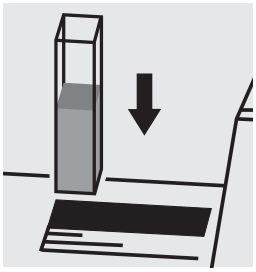
Add 1.2 ml of **PO_4-1** with piette and mix.



Transfer the solution into a corresponding cell.



Select method with AutoSelector.



Place the cell into the cell compartment.

Important:

For the determination of **total phosphorus = sum of orthophosphate, polyphosphate and organophosphate** either Phosphate Cell Test, Cat. No. 114543, 114729, and 100673 or Phosphate Test, Cat. No. 114848 in conjunction with Crack Set 10/10C, Cat. No. 114687 resp. 114688 can be used.

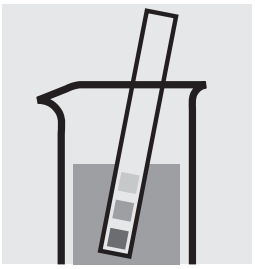
Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) ready-for-use phosphate standard solution Certipur®, Cat.No. 119898, concentration 1000 mg/l PO_4^{3-}, can be used after diluting accordingly.

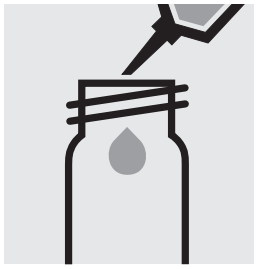
Platinum in water and wastewater

Application

Measuring range:	0.10 – 1.25 mg/l Pt 10-mm cell
Attention!	The measurement is carried out at 690 nm in a 10-mm rectangular cell against a blank, prepared from distilled water (Water for analysis EMSURE®, Cat.No. 116754, is recommended) and the reagents in an analogous manner.



Check the pH of the sample, specified range: pH 2 – 5.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.

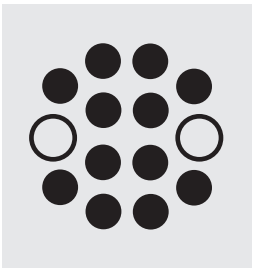


Pipette 5.0 ml of the sample into an empty round cell (Empty cells, Cat.No. 114724).

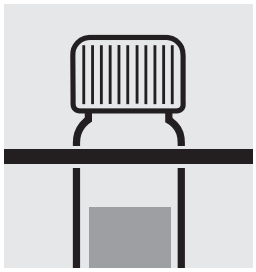
Add 1.0 ml of **reagent 1** with pipette, close the cell with the screw cap, and mix.

Add 0.50 ml of **reagent 2** with pipette, close the cell with the screw cap, and mix.

Check the pH of the sample, specified value: pH 6.5.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.

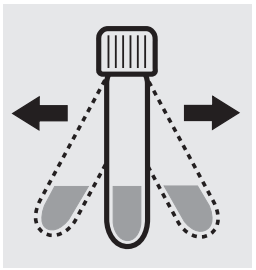


Heat the cell in the thermoreactor at 100 °C for 5 minutes.

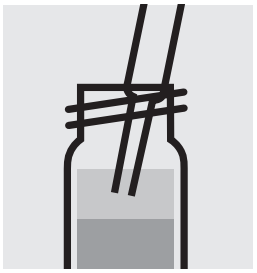


Remove the cell from the thermoreactor and place in a test-tube rack to cool to room temperature.

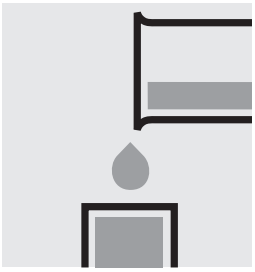
Add 5.0 ml **Isobutylmethylketone GR** (Cat.No. 106146) with pipette, close the cell with the screw cap.



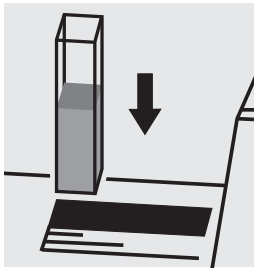
Shake the cell vigorously for 1 minute.
Leave to stand to allow phases to separate.



Aspirate the organic-clear upper phase from the tube with pipette and dry over **sodium sulfate anhydrous** (Cat.No. 106649).



Transfer the dried solution into a rectangular cell.



Place the cell into the cell compartment.
Select method no. **134**.

Note:

Empty cells with screw caps, Cat.No. 114724 are recommended for the preparation. These cells can be sealed with the screw caps, thus enabling a hazard-free mixing of the sample.

Important:

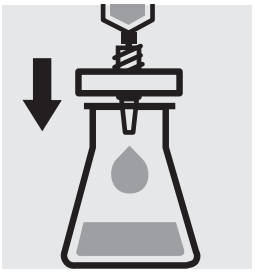
The exact composition and preparation of the reagents 1 and 2 used are given in the corresponding application, which also includes further information on the method employed. This application can be downloaded directly at www.analytical-test-kits.com.

Potassium

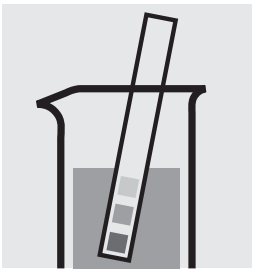
114562

Cell Test

Measuring range:	5.0 – 50.0 mg/l K Expression of results also possible in mmol/l.



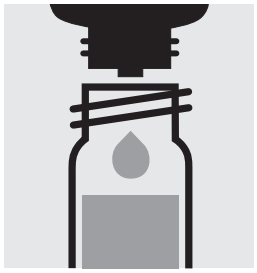
Filter turbid samples.



Check the pH of the sample, specified range: pH 3 – 12.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.

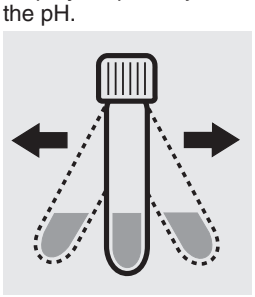
Pipette 2.0 ml of the sample into a reaction cell, close with the screw cap, and mix.

Check the pH, specified range: pH 10.0 – 11.5.



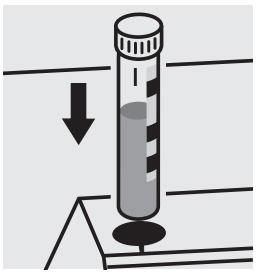
Add 6 drops of **K-1K**, close the cell with the screw cap, and mix.

Add 1 level blue micro-spoon of **K-2K**, close the cell with the screw cap.



Shake the cell vigorously to dissolve the solid substance.

Reaction time:
5 minutes



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

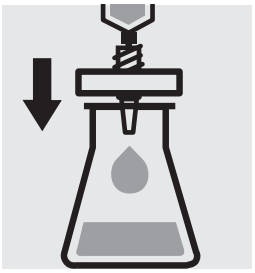
To check the measurement system (test reagents, measurement device, and handling) ready-for-use potassium standard solution Certipur®, Cat.No. 170230, concentration 1000 mg/l K, can be used after diluting accordingly.

Potassium

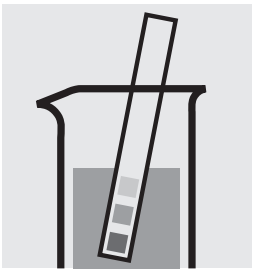
100615

Cell Test

Measuring range:	30 – 300 mg/l K Expression of results also possible in mmol/l.



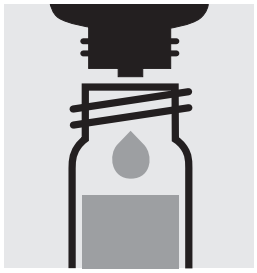
Filter turbid samples.



Check the pH of the sample, specified range: pH 3 – 12.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.

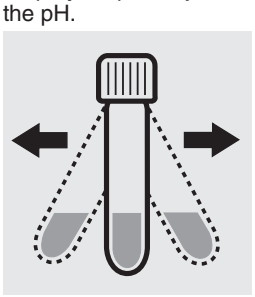
Pipette 0.50 ml of the sample into a reaction cell, close with the screw cap, and mix.

Check the pH, specified range: pH 10.0 – 11.5.



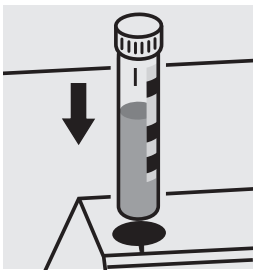
Add 6 drops of **K-1K**, close the cell with the screw cap, and mix.

Add 1 level blue micro-spoon of **K-2K**, close the cell with the screw cap.



Shake the cell vigorously to dissolve the solid substance.

Reaction time:
5 minutes



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) ready-for-use potassium standard solution Certipur®, Cat.No. 170230, concentration 1000 mg/l K, can be used after diluting accordingly.

Residual Hardness

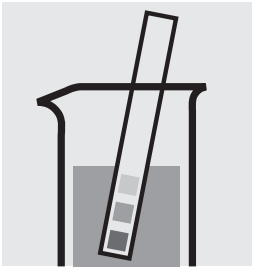
114683

Cell Test

Measuring range:	0.50 – 5.00 mg/l Ca 0.070 – 0.700 °d 0.087 – 0.874 °e 0.12 – 1.25 °f

Measuring range:	0.70 – 7.00 mg/l CaO 1.2 – 12.5 mg/l $CaCO_3$

Expression of results also possible in mmol/l.

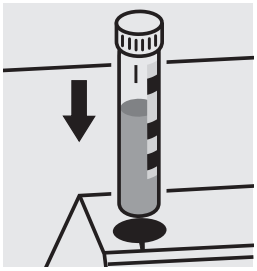


Check the pH of the sample, specified range: pH 5– 8.
If required, add dilute sodium hydroxide solution or hydrochloric acid drop by drop to adjust the pH.

Pipette 4.0 ml of the sample into a reaction cell, close with the screw cap, and mix.

Add 0.20 ml of **RH-1K**, close the cell with the screw cap, and mix.

Reaction time:
10 minutes, **measure immediately**.



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

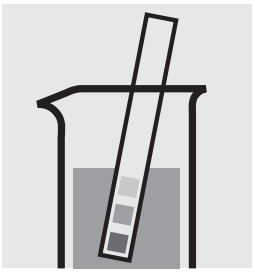
To check the measurement system (test reagents, measurement device, and handling) ready-for-use calcium standard solution Certipur®, Cat.No. 119778, concentration 1000 mg/l Ca, can be used after diluting accordingly. (Pay attention to pH value!)

Silicate (Silicic Acid)

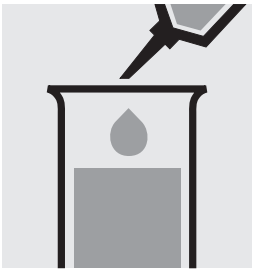
114794

Test

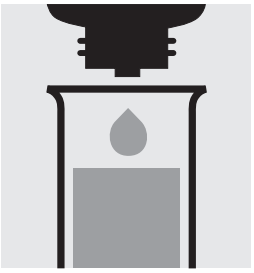
Measuring	0.21 – 10.70 mg/l SiO_2	0.10 – 5.00 mg/l Si	10-mm cell
range:	0.10 – 5.35 mg/l SiO_2	0.05 – 2.50 mg/l Si	20-mm cell
	0.011 – 1.600 mg/l SiO_2	0.005 – 0.750 mg/l Si	50-mm cell
	Expression of results also possible in mmol/l.		



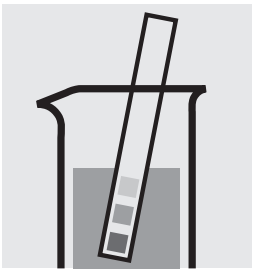
Check the pH of the sample, specified range: pH 2– 10.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.



Pipette 5.0 ml of the sample into a test tube.

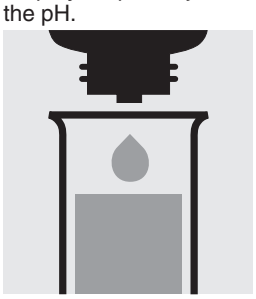


Add 3 drops of **Si-1** and mix.

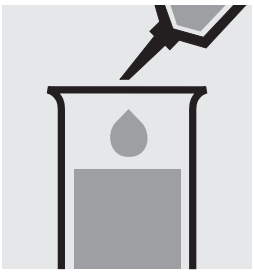


Check the pH, specified range: pH 1.2 – 1.6.

Reaction time: 3 minutes

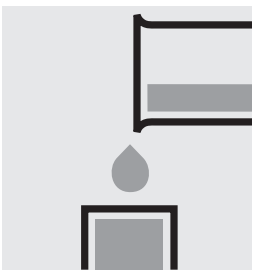


Add 3 drops of **Si-2** and mix.

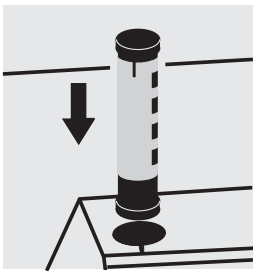


Add 0.50 ml of **Si-3** with pipette and mix.

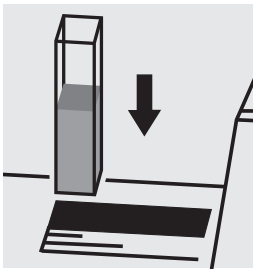
Reaction time: 10 minutes



Transfer the solution into a corresponding cell.



Select method with AutoSelector.



Place the cell into the cell compartment.

Important:

To measure in the 50-mm cell, the sample volume and the volume of the reagents have to be doubled for each. Alternatively, the semi-microcell, Cat.No. 173502, can be used.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) ready-for-use silicon standard solution Certipur®, Cat.No. 170236, concentration 1000 mg/l Si, can be used after diluting accordingly. (Attention! Do **not** store standard solutions in glass vessels - see section "Standard solutions"!)

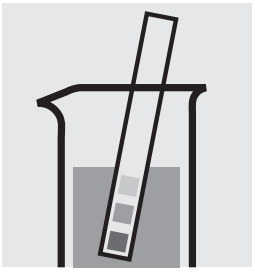
Silicate (Silicic Acid)

100857

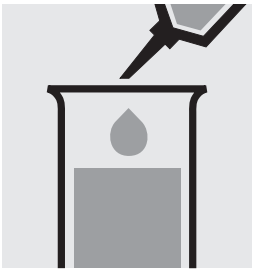
Test

Measuring	1.1– 107.0 mg/l SiO_2	0.5– 50.0 mg/l Si	10-mm cell
range:	11 –1070 mg/l SiO_2	5 –500 mg/l Si	10-mm cell
	Expression of results also possible in mmol/l.		

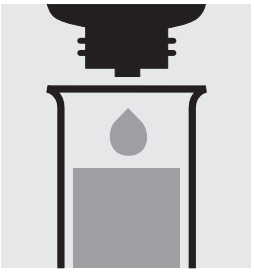
Measuring range: 1.1 – 107.0 mg/l SiO_2



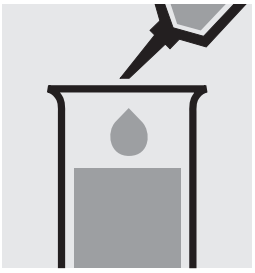
Check the pH of the sample, specified range: pH 2– 10.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.



Pipette 4.0 ml of the sample into a test tube.

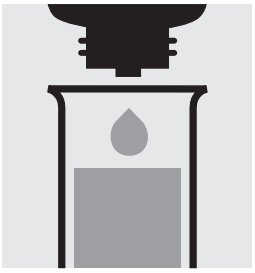


Add 4 drops of **Si-1** and mix.



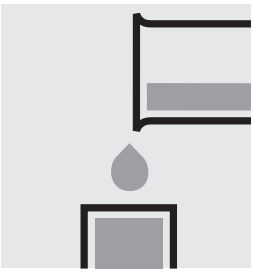
Add 2.0 ml of **Si-2** with pipette and mix.

Reaction time: 2 minutes

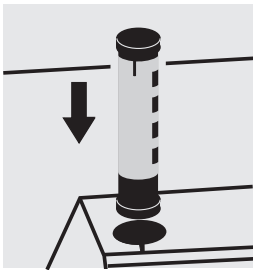


Add 4 drops of **Si-3** and mix.

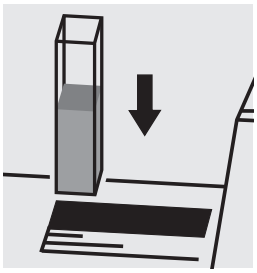
Reaction time: 2 minutes



Transfer the solution into a cell.

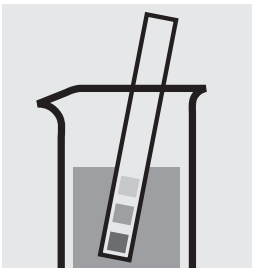


Select method with AutoSelector measuring range 0.5 – 50.0 mg/l Si.

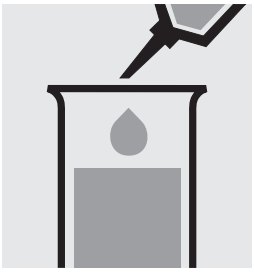


Place the cell into the cell compartment.

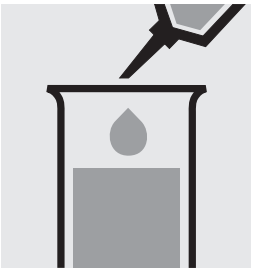
Measuring range: 11 – 1070 mg/l SiO_2



Check the pH of the sample, specified range: pH 2– 10.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.



Pipette 5.0 ml of distilled water (Water for analysis EMSURE®, Cat.No. 116754, is recommended) into a test tube.



Add 0.50 ml of the sample with pipette and mix.

Continue as mentioned above; starting from the addition of **Si-1** (Fig. 3). Select method with AutoSelector measuring range 5 – 500 mg/l Si.

Quality assurance:

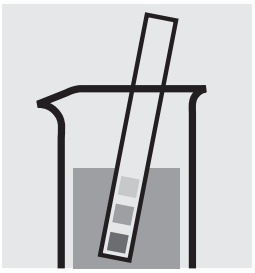
To check the measurement system (test reagents, measurement device, and handling) ready-for-use silicon standard solution Certipur®, Cat.No. 170236, concentration 1000 mg/l Si, can be used after diluting accordingly. (Attention! Do **not** store standard solutions in glass vessels - see section "Standard solutions"!)

Silicate (Silicic Acid)

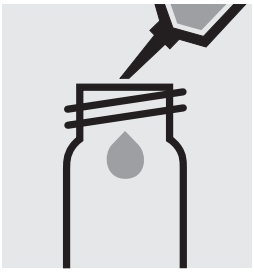
101813

Test

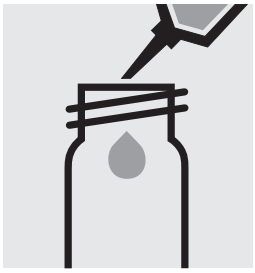
Measuring	0.0005 – 0.5000 mg/l SiO_2	0.0002 – 0.2337 mg/l Si	50-mm cell
range:	Expression of results also possible in mmol/l.		



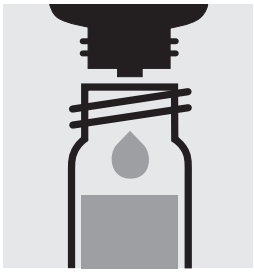
Check the pH of the sample, specified range: pH 2– 10.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.



Pipette 10 ml of the sample into a plastic vessel (**Flat-bottomed tubes, Cat.No. 117988**).



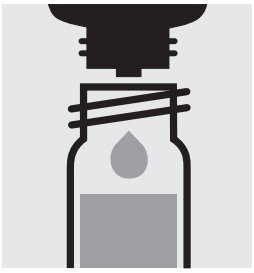
Pipette 10 ml of distilled water (Water Ultrapur, Cat.No. 101262, is recommended) into a second plastic vessel (**Flat-bottomed tubes, Cat.No. 117988**).
(Blank)



Add to each vessel 3 drops of **Si-1**, close with the screw cap, and mix.

Check the pH, specified range: pH 1.2 – 1.6.

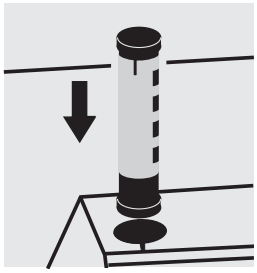
Reaction time:
5 minutes



Add to each vessel 3 drops of **Si-2**, close with the screw cap, and mix.

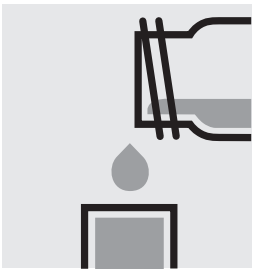
Add to each vessel 0.50 ml of **Si-3** with pipette, close with the screw cap, and mix.

Reaction time:
5 minutes

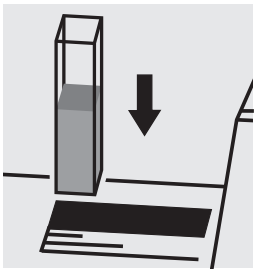


Select method with AutoSelector.

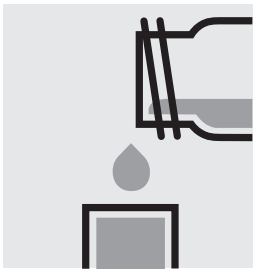
Configure the photometer for blank-measurement.



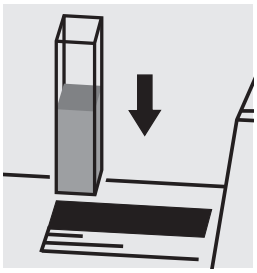
Transfer the blank into a rectangular cell and measure **immediately**.



Insert the blank cell into the cell compartment.



Transfer the measurement sample into a rectangular cell and measure **immediately**.



Insert the cell containing the sample into the cell compartment.

Important:

No glass equipment may be used in the course of the determination (e.g. pipettes etc.)!

Quality assurance:

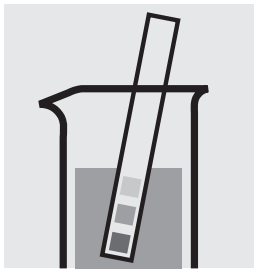
To check the measurement system (test reagents, measurement device, and handling) ready-for-use silicon standard solution Certipur®, Cat.No. 170236, concentration 1000 mg/l Si, can be used after diluting accordingly (Attention! Do **not** store standard solutions in glass vessels - see section "Standard solutions").

Silver

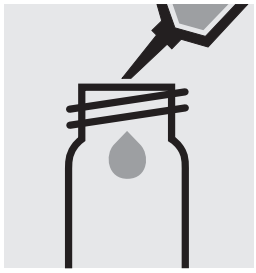
114831

Test

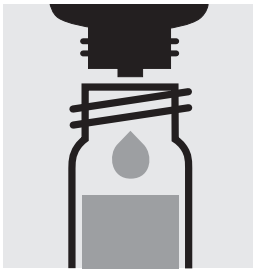
Measuring	0.50 – 3.00 mg/l Ag	10-mm cell
range:	0.25 – 1.50 mg/l Ag	20-mm cell
	Expression of results also possible in mmol/l.	



Check the pH of the sample, specified range: pH 4– 10.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.

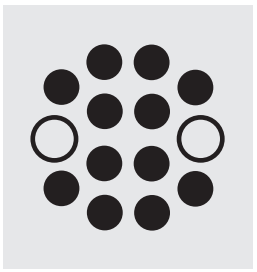


Pipette 10 ml of the sample into an empty round cell (Empty cells, Cat.No. 114724).

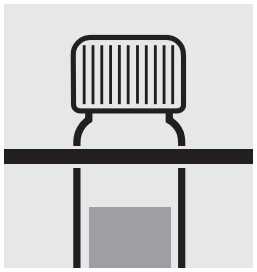


Add 2 drops of **Ag-1.**

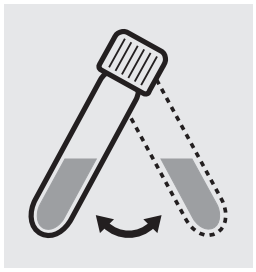
Add 1 level green micro-spoon of **Ag-2**, close the cell with the screw cap.



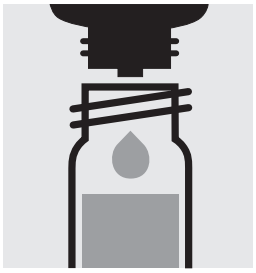
Heat the cell in the thermoreactor at 120 °C (100 °C) for 1 hours.



Remove the cell from the thermoreactor and place in a test-tube rack to cool to room temperature.

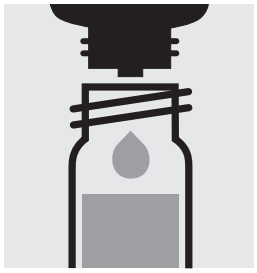


Swirl the cell before opening.

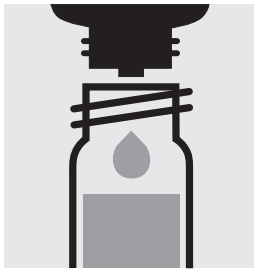


Add 3 drops of **Ag-3**, close with the screw cap, and mix.

Check the pH, specified range: pH 4 – 10.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.



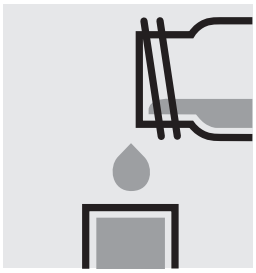
Add 1 drop of **Ag-4**, close with the screw cap, and mix.



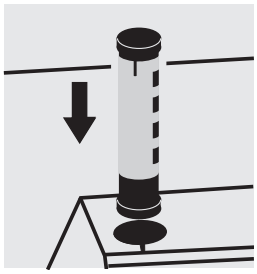
Add 5 drops of **Ag-5**, close with the screw cap, and mix.

Add 1.0 ml of **Ag-6**, close with the screw cap, and mix.

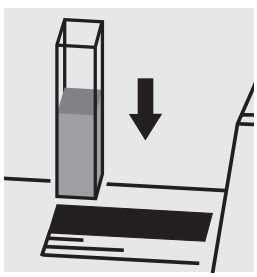
Reaction time: 5 minutes



Transfer the solution into a corresponding rectangular cell.



Select method with AutoSelector.



Place the cell into the cell compartment.

Important:

Very high silver concentrations in the sample produce turbid solutions (measurement solution should be clear). In such cases the sample must be diluted (plausibility check).

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) ready-for-use silver standard solution Certipur®, Cat.No. 119797, concentration 1000 mg/l Ag, can be used after diluting accordingly.

Sodium

in nutrient solutions

100885

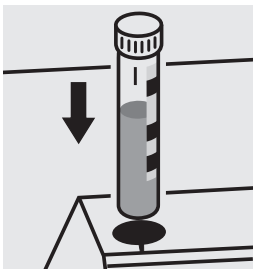
Cell Test

Measuring range:	10 – 300 mg/l Na Expression of results also possible in mmol/l.

Pipette 0.50 ml of **Na-1K** into a reaction cell and mix.

Add 0.50 ml of the sample with pipette, close the cell with the screw cap, and mix.

Reaction time: 1 minute



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

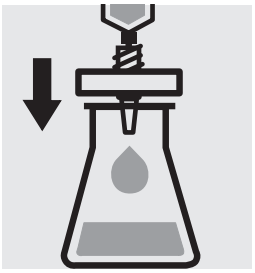
To check the measurement system (test reagents, measurement device, and handling) ready-for-use chloride standard solution Certipur®, Cat.No. 119897, concentration 1000 mg/l Cl^- (corresponds to 649 mg/l Na), can be used after diluting accordingly (see section “Standard solutions”).

Spectral Absorption Coefficient

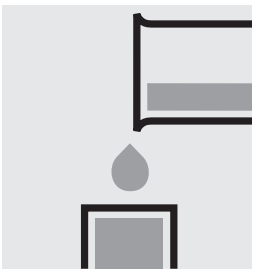
α(254)

analogous to **DIN 38404**

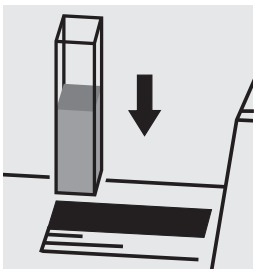
Measuring	3 – 250 m^{-1}	254 nm	10-mm cell
range:	1 – 125 m^{-1}	254 nm	20-mm cell
	0.5 – 50.0 m^{-1}	254 nm	50-mm cell



Filter sample solution through a membrane filter with 0.45 µm pore size.



Transfer the solution into a corresponding cell.



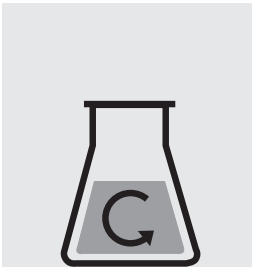
Place the cell into the cell compartment, select method no. **300**.

Spectral Attenuation Coefficient

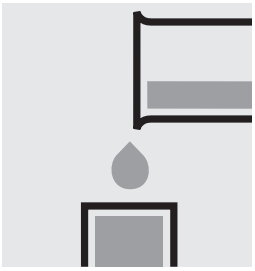
μ(254)

analogous to **DIN 38404**

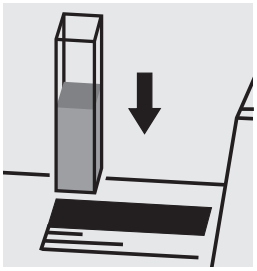
Measuring	3 – 250 m^{-1}	254 nm	10-mm cell
range:	1 – 125 m^{-1}	254 nm	20-mm cell
	0.5 – 50.0 m^{-1}	254 nm	50-mm cell



Shake the unfiltered sample solution to evenly suspend the turbidity-causing substances. Do not disperse the contents, **measure immediately**.



Transfer the solution into a corresponding cell.



Place the cell into the cell compartment, select method no. **301**.

Note:

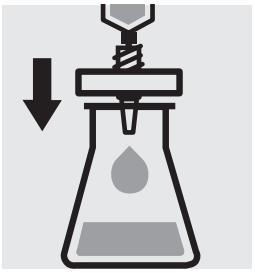
When the turbidity correction function is activated (see Description of Function, section 4.5.9 “Automatic Turbidity correction”), the **corrected spectral attenuation coefficient μ(254)korr** can be determined.
The turbidity correction is carried out as per DIN 38404 at 550 nm.

Spectral Absorption Coefficient

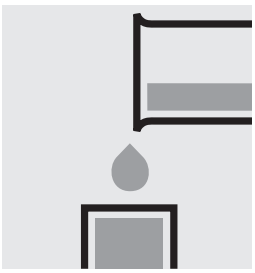
$\alpha(436)$

analogous to **EN ISO 7887**

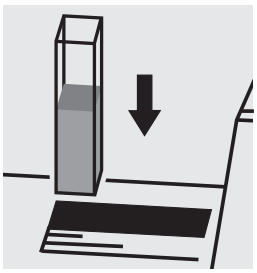
Measuring	3 – 250 m^{-1}	436 nm	10-mm cell
range:	1 – 125 m^{-1}	436 nm	20-mm cell
	0.5 – 50.0 m^{-1}	436 nm	50-mm cell



Filter sample solution through a membrane filter with 0.45 µm pore size.



Transfer the solution into a corresponding cell.



Place the cell into the cell compartment, select method no. **302**.

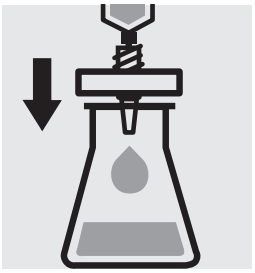
Notes:
Filtered sample = true color.
Unfiltered sample = apparent color.

Sulfate

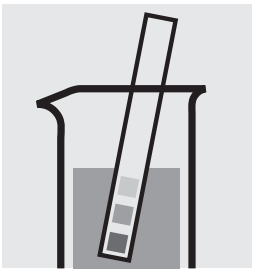
102532

Cell Test

Measuring range:	1.0 – 50.0 mg/l SO_4 Expression of results also possible in mmol/l.



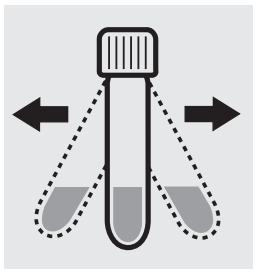
Filter turbid samples.



Check the pH of the sample, specified range: pH 2– 10.
If required, add dilute sodium hydroxide solution or hydrochloric acid drop by drop to adjust the pH.

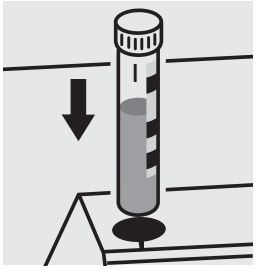
Pipette 10 ml of the sample into a reaction cell, close with the screw cap, and mix.

Add 1 level green micro-spoon of **SO_4-1K**, close the cell with the screw cap.



Shake the cell vigorously to dissolve the solid substance**.**

Reaction time:
2 minutes, **measure immediately**.



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

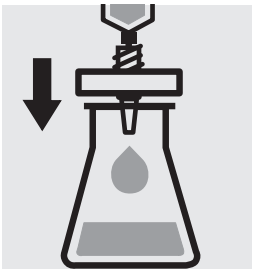
To check the measurement system (test reagents, measurement device, and handling) ready-for-use sulfate standard solution Certipur®, Cat.No. 119813, concentration 1000 mg/l SO_4^{2-}, can be used after diluting accordingly.

Sulfate

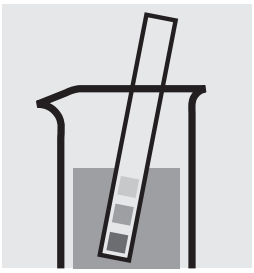
114548

Cell Test

Measuring range:	5 – 250 mg/l SO_4 Expression of results also possible in mmol/l.



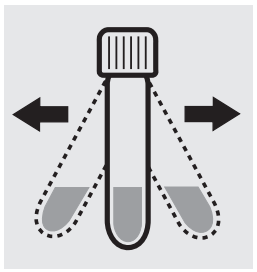
Filter turbid samples.



Check the pH of the sample, specified range: pH 2– 10.
If required, add dilute sodium hydroxide solution or hydrochloric acid drop by drop to adjust the pH.

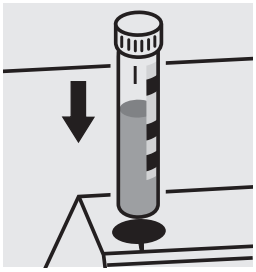
Pipette 5.0 ml of the sample into a reaction cell, close with the screw cap, and mix.

Add 1 level green micro-spoon of **SO_4-1K**, close the cell with the screw cap.



Shake the cell vigorously to dissolve the solid substance**.**

Reaction time:
2 minutes, **measure immediately**.



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) we recommended to use Spectroquant® CombiCheck 10, Cat.No. 114676, or the Standard solution for photometric applications, CRM, Cat.No. 125050 and 125051.

Ready-for-use sulfate standard solution Certipur®, Cat.No. 119813, concentration 1000 mg/l SO_4^{2-}, can also be used after diluting accordingly.

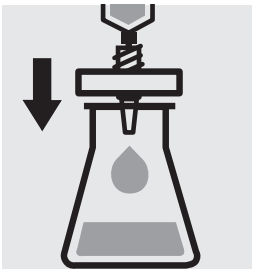
To check for sample-dependent effects the use of addition solutions (e.g. in CombiCheck 10) is highly recommended.

Sulfate

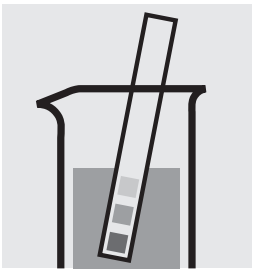
100617

Cell Test

Measuring range:	50 – 500 mg/l SO_4 Expression of results also possible in mmol/l.



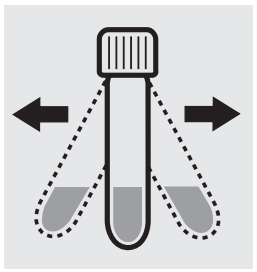
Filter turbid samples.



Check the pH of the sample, specified range: pH 2– 10.
If required, add dilute sodium hydroxide solution or hydrochloric acid drop by drop to adjust the pH.

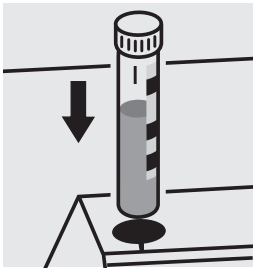
Pipette 2.0 ml of the sample into a reaction cell, close with the screw cap, and mix.

Add 1 level green micro-spoon of **SO_4-1K**, close the cell with the screw cap.



Shake the cell vigorously to dissolve the solid substance**.**

Reaction time:
2 minutes, **measure immediately**.



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) we recommended to use Spectroquant® CombiCheck 10, Cat.No. 114676, or the Standard solution for photometric applications, CRM, Cat.No. 125051 and 125052.

Ready-for-use sulfate standard solution Certipur®, Cat.No. 119813, concentration 1000 mg/l SO_4^{2-}, can also be used after diluting accordingly.

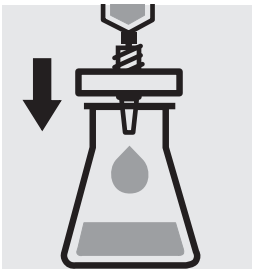
To check for sample-dependent effects the use of addition solutions (e.g. in CombiCheck 10) is highly recommended.

Sulfate

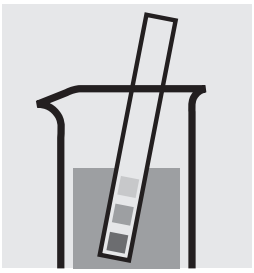
114564

Cell Test

Measuring range:	100 – 1000 mg/l SO_4 Expression of results also possible in mmol/l.



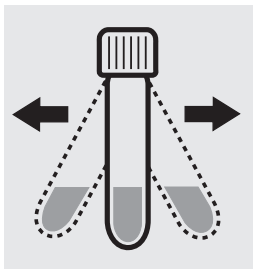
Filter turbid samples.



Check the pH of the sample, specified range: pH 2– 10.
If required, add dilute sodium hydroxide solution or hydrochloric acid drop by drop to adjust the pH.

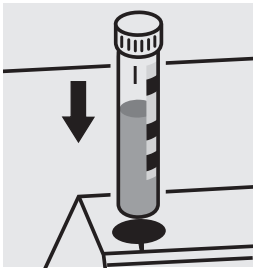
Pipette 1.0 ml of the sample into a reaction cell, close with the screw cap, and mix.

Add 1 level green micro-spoon of **SO_4-1K**, close the cell with the screw cap.



Shake the cell vigorously to dissolve the solid substance**.**

Reaction time:
2 minutes, **measure immediately**.



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) we recommended to use Spectroquant® CombiCheck 20, Cat.No. 114675, or the Standard solution for photometric applications, CRM, Cat.No. 125051, 125052 and 125053.

Ready-for-use sulfate standard solution Certipur®, Cat.No. 119813, concentration 1000 mg/l SO_4^{2-}, can also be used after diluting accordingly.

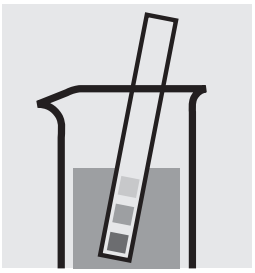
To check for sample-dependent effects the use of addition solutions (e.g. in CombiCheck 20) is highly recommended.

Sulfate

114791

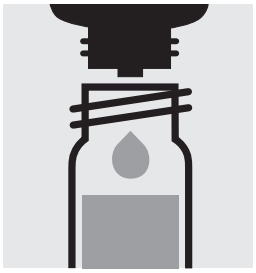
Test

Measuring range:	25 – 300 mg/l SO_4 Expression of results also possible in mmol/l.	10-mm cell



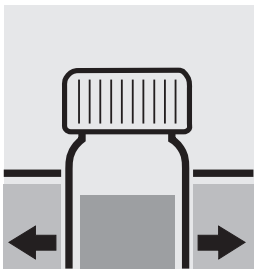
Check the pH of the sample, specified range: pH 2– 10.
If required, add dilute sodium hydroxide solution or hydrochloric acid drop by drop to adjust the pH.

Pipette 2.5 ml of the sample into a test tube with screw cap.



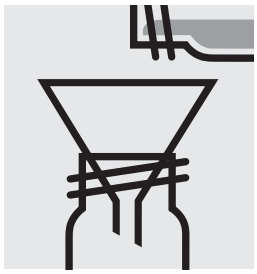
Add 2 drops of **SO_4-1** and mix.

Add 1 level green microspoon of **SO_4-2**, close the test tube with the screw cap, and mix.

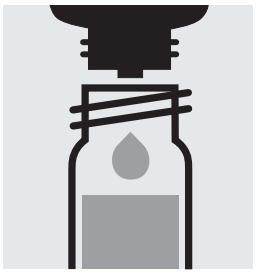


Temper the test tube in a water bath at 40 °C for 5 minutes.

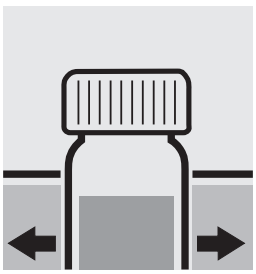
Add 2.5 ml of **SO_4-3** with pipette and mix.



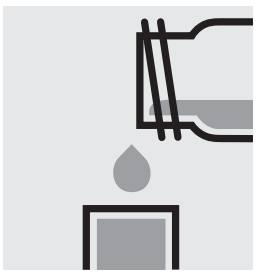
Filter the content of the test tube with a round filter into another test tube with screw cap.



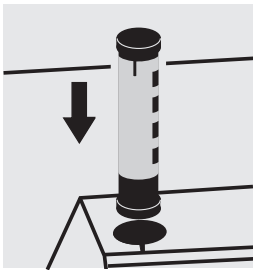
Add 4 drops of **SO_4-4** to the filtrate, close the test tube with the screw cap, and mix.



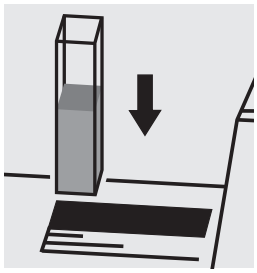
Temper the test tube again in the water bath for 7 minutes.



Transfer the solution into a cell.



Select method with AutoSelector.



Place the cell into the cell compartment.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) we recommended to use Spectroquant® CombiCheck 10, Cat.No. 114676, or the Standard solution for photometric applications, CRM, Cat.No. 125050 and 125051.

Ready-for-use sulfate standard solution Certipur®, Cat.No. 119813, concentration 1000 mg/l SO_4^{2-}, can also be used after diluting accordingly.

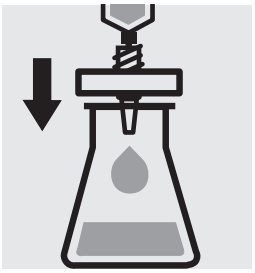
To check for sample-dependent effects the use of addition solutions (e.g. in CombiCheck 10) is highly recommended.

Sulfate

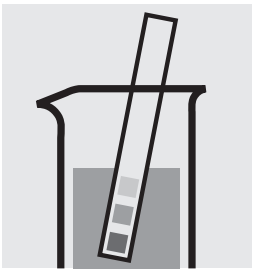
101812

Test

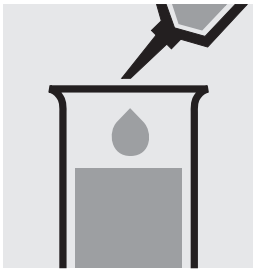
Measuring	2.5 – 50.0 mg/l SO_4	10-mm cell
range:	1.3 – 25.0 mg/l SO_4	20-mm cell
	0.50 – 10.00 mg/l SO_4	50-mm cell
	Expression of results also possible in mmol/l.	



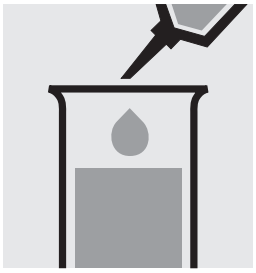
Filter turbid samples.



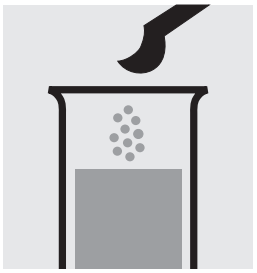
Check the pH of the sample, specified range: pH 2– 10.
If required, add dilute sodium hydroxide solution or hydrochloric acid drop by drop to adjust the pH.



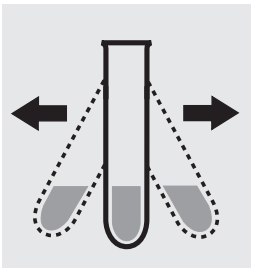
Pipette 0.50 ml of **SO_4-1** into a test tube.



Add 10 ml of the sample with pipette and mix.

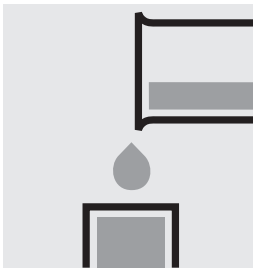


Add 1 level green microspoon of **SO_4-2**.

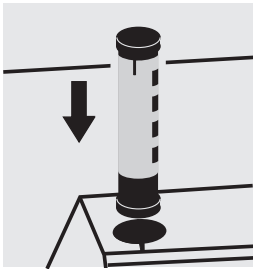


Shake the test tube vigorously to dissolve the solid substance.

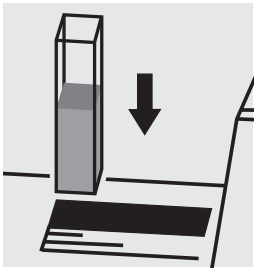
Reaction time:
2 minutes, **measure immediately**.



Transfer the solution into a corresponding cell.



Select method with AutoSelector.



Place the cell into the cell compartment.

Quality assurance:

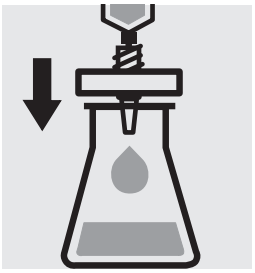
To check the measurement system (test reagents, measurement device, and handling) ready-for-use sulfate standard solution Certipur®, Cat.No. 119813, concentration 1000 mg/l SO_4^{2-}, can be used after diluting accordingly.

Sulfate

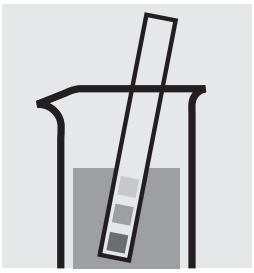
102537

Test

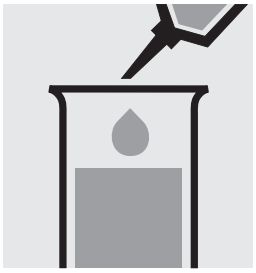
Measuring range:	5 – 300 mg/l SO_4 Expression of results also possible in mmol/l.	10-mm cell



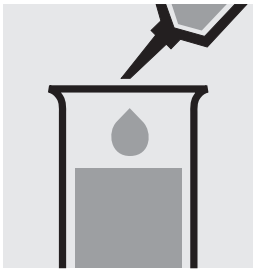
Filter turbid samples.



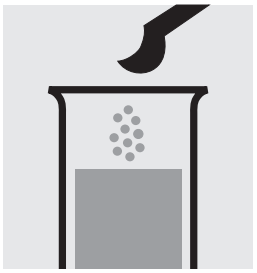
Check the pH of the sample, specified range: pH 2– 10.
If required, add dilute sodium hydroxide solution or hydrochloric acid drop by drop to adjust the pH.



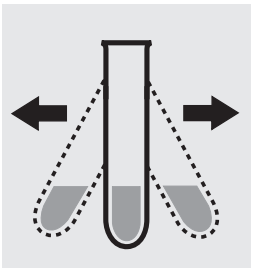
Pipette 0.50 ml of **SO_4-1** into a test tube.



Add 5.0 ml of the sample with pipette and mix.

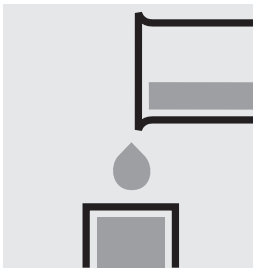


Add 1 level blue microspoon of **SO_4-2**.

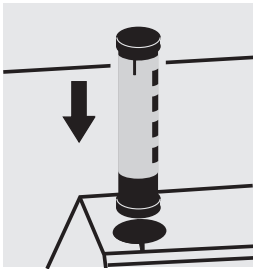


Shake the test tube vigorously to dissolve the solid substance.

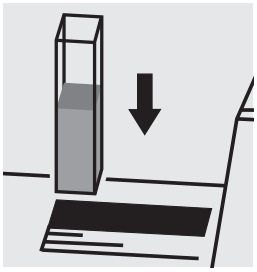
Reaction time:
2 minutes, **measure immediately**.



Transfer the solution into a corresponding cell.



Select method with AutoSelector.



Place the cell into the cell compartment.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) we recommended to use Spectroquant® CombiCheck 10, Cat.No. 114676, or the Standard solution for photometric applications, CRM, Cat.No. 125050 and 125051.

Ready-for-use sulfate standard solution Certipur®, Cat.No. 119813, concentration 1000 mg/l SO_4^{2-}, can also be used after diluting accordingly.

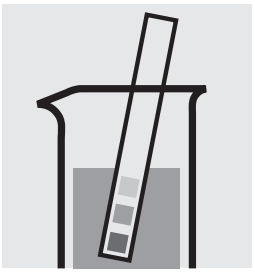
To check for sample-dependent effects the use of addition solutions (e.g. in CombiCheck 10) is highly recommended.

Sulfide

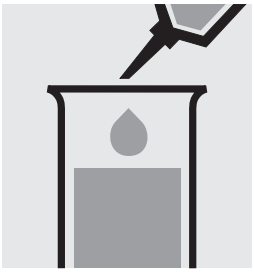
114779

Test

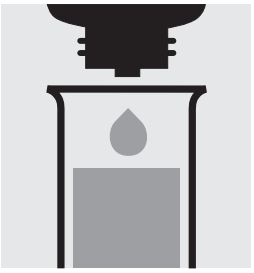
Measuring	0.10 – 1.50 mg/l S	0.10 – 1.55 mg/l HS	10-mm cell
range:	0.050 – 0.750 mg/l S	0.052 – 0.774 mg/l HS	20-mm cell
	0.020 – 0.500 mg/l S	0.021 – 0.516 mg/l HS	50-mm cell
	Expression of results also possible in mmol/l.		



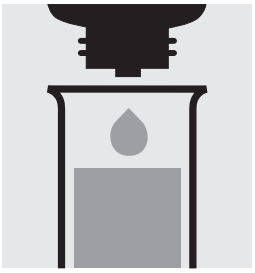
Check the pH of the sample, specified range: pH 2 – 10.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.



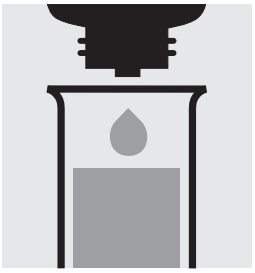
Pipette 5.0 ml of the sample into a test tube.



Add 1 drop of **S-1** and mix.

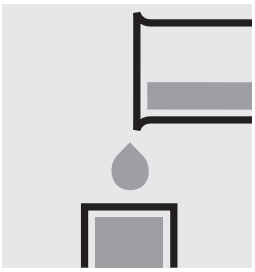


Add 5 drops of **S-2** and mix.

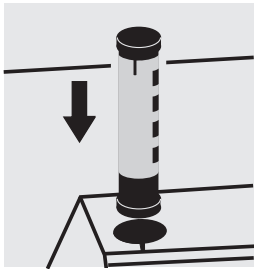


Add 5 drops of **S-3** and mix.

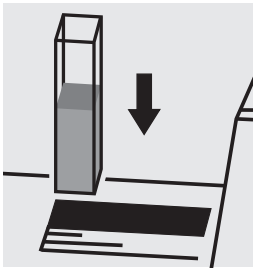
Reaction time:
1 minute



Transfer the solution into a corresponding cell.



Select method with AutoSelector.



Place the cell into the cell compartment.

Important:

To measure in the 50-mm cell, the sample volume and the volume of the reagents have to be doubled for each. Alternatively, the semi-microcell, Cat.No. 173502, can be used.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) a sulfide standard solution must be prepared from sodium sulfide GR (see section “Standard solutions”).

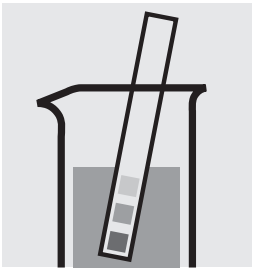
Sulfite

114394

Cell Test

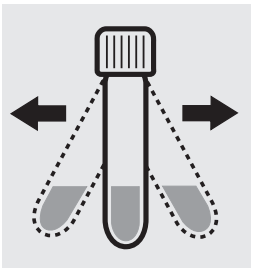
Measuring	1.0 – 20.0 mg/l SO_3	0.8 – 16.0 mg/l SO_2	Round cell
range:	0.05 – 3.00 mg/l SO_3	0.04 – 2.40 mg/l SO_2	50-mm cell
	Expression of results also possible in mmol/l.		

Measuring range: 1.0 – 20.0 mg/l SO_3



Check the pH of the sample, specified range: pH 4 – 9.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.

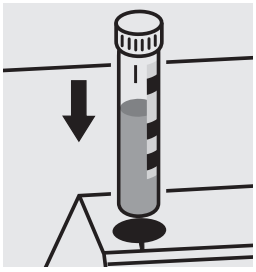
Add 1 level grey micro-spoon of **SO_3-1K** into a reaction cell, close with the screw cap.



Shake the cell vigorously to dissolve the solid substance.

Add 3.0 ml of the sample with pipette, close the cell with the screw cap, and mix.

Reaction time: 2 minutes



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

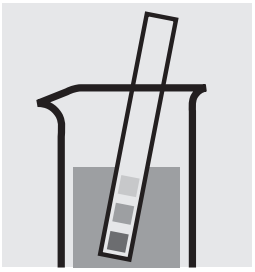
To check the measurement system (test reagents, measurement device, and handling) a sulfite standard solution must be prepared from sodium sulfite GR, Cat.No. 106657 (see section “Standard solutions”).

Sulfite

114394

Cell Test

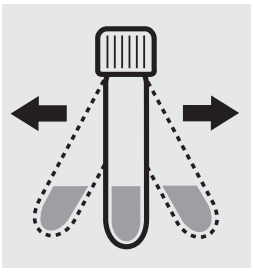
Measuring range: 0.05 – 3.00 mg/l SO_3



Check the pH of the sample, specified range: pH 4– 9.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.

Select method **SO_3 sens** in the menu (method no. 127).

Add 1 level grey microspoon each of **SO_3-1K** into two reaction cells, close with the screw cap.

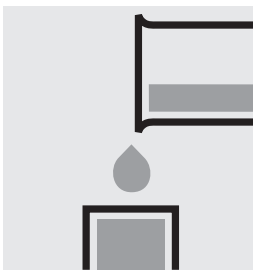


Shake both cells vigorously to dissolve the solid substance.

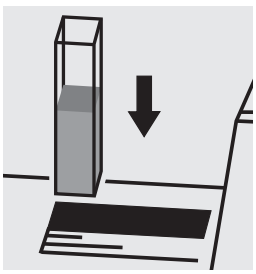
Add 7.0 ml of the sample with pipette to one reaction cell, close with the screw cap, and mix.

Add 7.0 ml of distilled water with pipette to the second reaction cell, close with the screw cap, and mix.
(Blank)

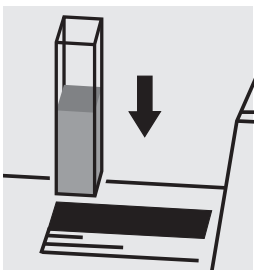
Reaction time:
2 minutes



Transfer both solutions into two separate 50-mm cells.



Place the blank cell into the cell compartment.



Place the cell containing the sample into the cell compartment.

Quality assurance:

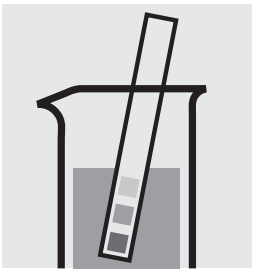
To check the measurement system (test reagents, measurement device, and handling) a sulfite standard solution must be prepared from sodium sulfite GR, Cat.No. 106657 (see section “Standard solutions”).

Sulfite

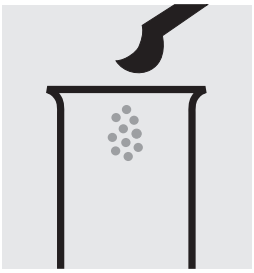
101746

Test

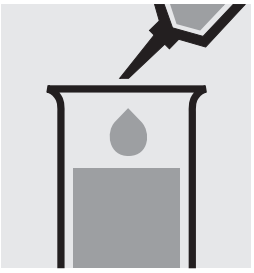
Measuring	1.0 – 60.0 mg/l SO_3	10-mm cell
range:	0.8 – 48.0 mg/l SO_2	10-mm cell
	Expression of results also possible in mmol/l.	



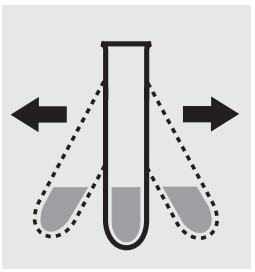
Check the pH of the sample, specified range: pH 4– 9.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.



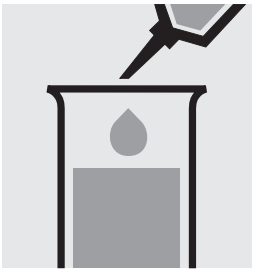
Place 1 level grey micro-spoon of **SO_3-1** into a dry test tube.



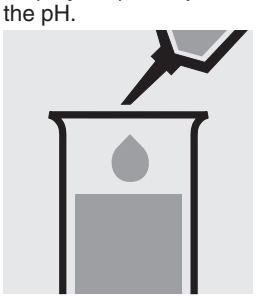
Add 3.0 ml of **SO_3-2** with pipette.



Shake vigorously to dissolve the solid substance.

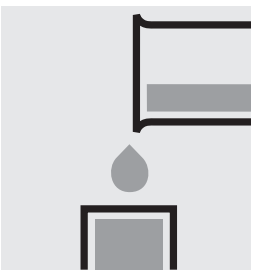


Add 5.0 ml of distilled water with pipette and mix.

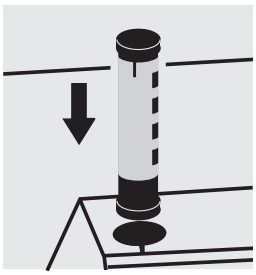


Add 2.0 ml of the sample with pipette and mix.

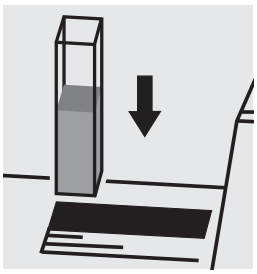
Reaction time:
2 minutes



Transfer the solution into a cell.



Select method with AutoSelector.



Place the cell into the cell compartment.

Quality assurance:

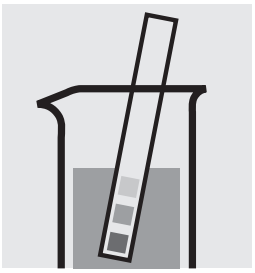
To check the measurement system (test reagents, measurement device, and handling) a sulfite standard solution must be prepared from sodium sulfite GR, Cat.No. 106657 (see section “Standard solutions”).

Surfactants (anionic)

114697

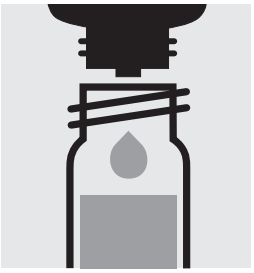
Cell Test

Measuring range:	0.05 – 2.00 mg/l MBAS*
	* **M**ethylene-**b**lue-**a**ctive **s**ubstances
	Expression of results also possible in mmol/l.

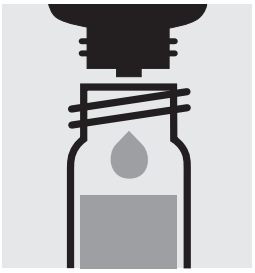


Check the pH of the sample, specified range: pH 5 – 10.
If required, add dilute sodium hydroxide solution or hydrochloric acid drop by drop to adjust the pH.

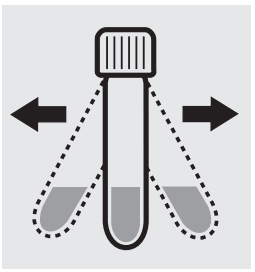
Pipette 5.0 ml of the sample into a reaction cell, **do not mix**!



Add 3 drops of **T-1K, do not mix**!

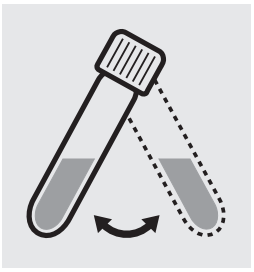


Add 2 drops of **T-2K**, close the cell with the screw cap.

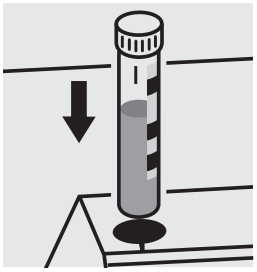


Shake the cell for 30 seconds.

Reaction time:
10 minutes



Swirl the cell before the measurement.



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

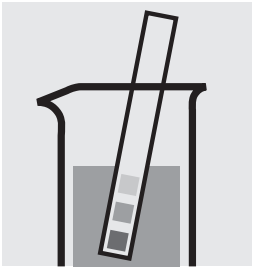
To check the measurement system (test reagents, measurement device, and handling) a surfactants standard solution must be prepared from dodecane-1-sulfonic acid sodium salt GR, Cat.No. 112146 (see section “Standard solutions”).

Surfactants (anionic)

102552

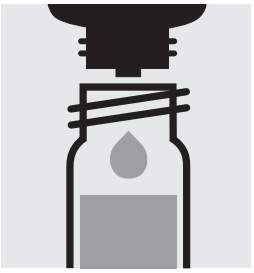
Cell Test

Measuring range:	0.05 – 2.00 mg/l MBAS*
	* **M**ethylene-**b**lue-**a**ctive **s**ubstances
	Expression of results also possible in mmol/l.

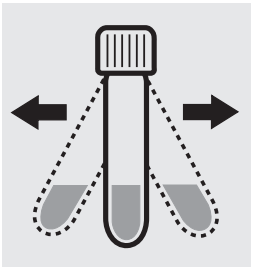


Check the pH of the sample, specified range: pH 5 – 10.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.

Pipette 5.0 ml of the sample into a reaction cell, **do not mix**!

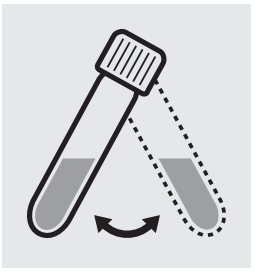


Add 2 drops of **T-1K**, close the cell with the screw cap.

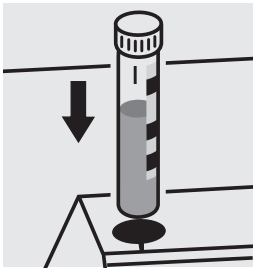


Shake the cell **vigorously for 30 seconds**.

Reaction time: 10 minutes



Swirl the cell before the measurement.



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

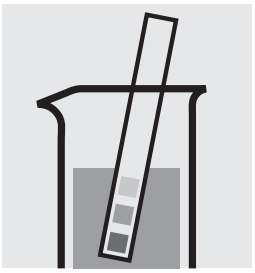
To check the measurement system (test reagents, measurement device, and handling) a surfactants standard solution must be prepared from dodecane-1-sulfonic acid sodium salt GR, Cat.No. 112146 (see section “Standard solutions”).

Surfactants (cationic)

101764

Cell Test

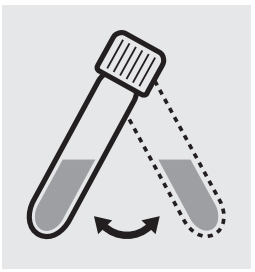
Measuring range:	0.05 – 1.50 mg/l surfactants (cationic) (calculated as N-cetyl-N,N,N-trimethylammonium bromide)



Check the pH of the sample, specified range: pH 3 – 8.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.

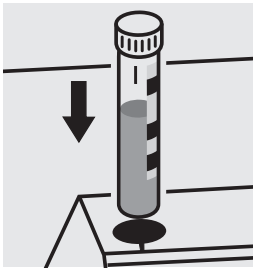
Pipette 5.0 ml of the sample into a reaction cell, **do not mix**!

Add 0.50 ml of **T-1K** with pipette and close with the screw cap.



Swirl the cell for 30 seconds.

Reaction time: 5 minutes



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

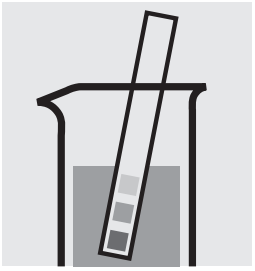
To check the measurement system (test reagents, measurement device, and handling) a surfactants standard solution must be prepared from N-cetyl-N,N,N-trimethylammonium bromide, Cat.No. 102342 (see section “Standard solutions”).

Surfactants (nonionic)

101787

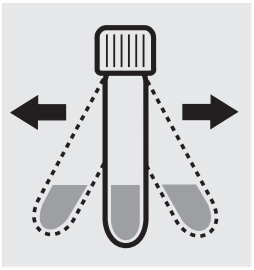
Cell Test

Measuring range:	0.010 – 7.50 mg/l surfactants (nonionic) (calculated as Triton® X-100)



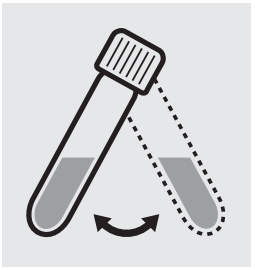
Check the pH of the sample, specified range: pH 3 – 9.
If required, add dilute sodium hydroxide solution or sulfuric acid drop by drop to adjust the pH.

Pipette 4.0 ml of the sample into a reaction cell. Close with the screw cap.

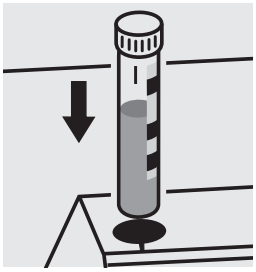


Shake the cell **for 1 minute vigorously**.

Reaction time: 2 minutes



Swirl the cell before measurement.



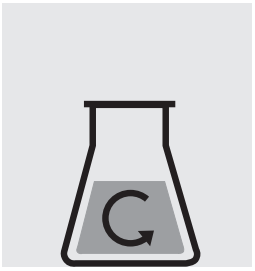
Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

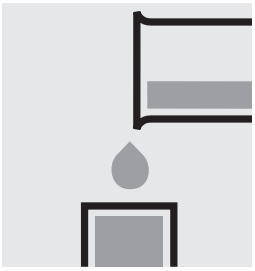
To check the measurement system (test reagents, measurement device, and handling) a surfactants standard solution must be prepared from Triton® X-100, Cat.No. 112298 (see section “Standard solutions”).

Suspended Solids

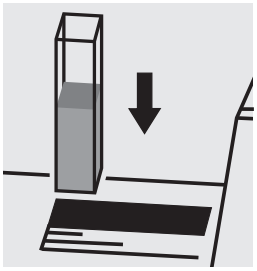
Measuring range: 25 – 750 mg/l of suspended solid 20-mm cell



Homogenize 500 ml of sample for 2 minutes in a mixer running at high speed.



Transfer the solution into a cell.



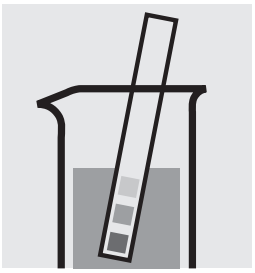
Place the cell into the cell compartment, select method no. **182**.

Tin

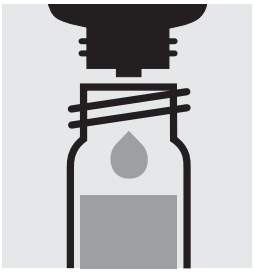
114622

Cell Test

Measuring range:	0.10 – 2.50 mg/l Sn Expression of results also possible in mmol/l.



Check the pH of the sample, specified range: pH < 3.
If required, add dilute sulfuric acid drop by drop to adjust the pH.

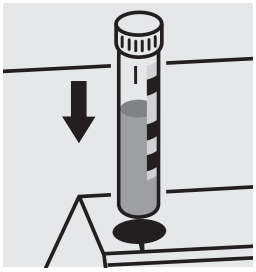


Add 6 drops of **Sn-1K** into a reaction cell, close with the screw cap, and mix.

Add 5.0 ml of the sample with pipette, close the cell with the screw cap, and mix.

Check the pH, specified range: pH 1.5 – 3.5.
If required, add dilute sulfuric acid drop by drop to adjust the pH.

Reaction time: 15 minutes



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) a tin standard solution must be prepared from ready-for-use tin standard solution Certipur®, Cat.No. 170242, concentration 1000 mg/l Sn (see section “Standard solutions”).

TOC

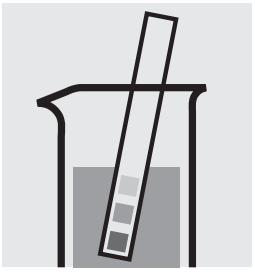
Total Organic Carbon

114878

Cell Test

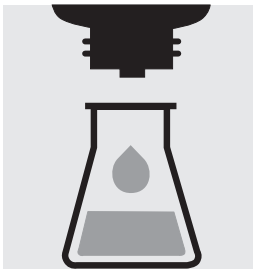
Measuring range: 5.0 – 80.0 mg/l TOC

Removal of inorganic bound carbon (TIC):

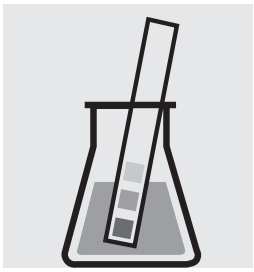


Check the pH of the sample, specified range: pH 2– 12.
If required, add dilute sulfuric acid drop by drop to adjust the pH.

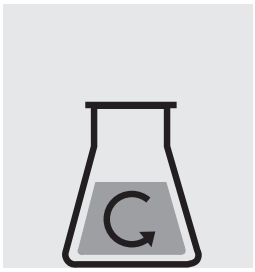
Place 25 ml of the sample into a suitable glass vessel.



Add 3 drops of **TOC-1K** and mix.



Check the pH, specified range pH < 2.5.

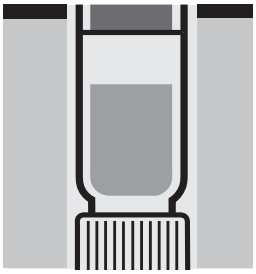


Stir for 10 minutes.

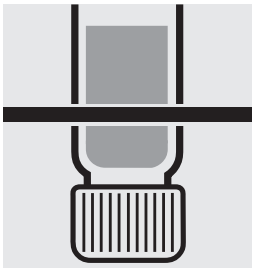
Preparation of measurement sample:

Pipette 3.0 ml of stirred sample into a reaction cell.

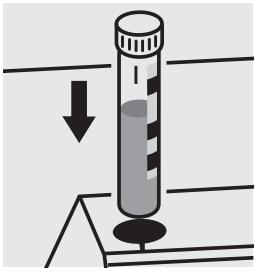
Add 1 level grey micro-spoon of **TOC-2K**. **Immediately** close the cell tightly with an **aluminium cap** (Cat.No. 173500).



Heat the cell, standing on its head, at 120 °C in the thermoreactor for 2 hours.



Remove the cell from the thermoreactor and let it, **standing on its head**, to cool for 1 hour.



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) a TOC standard solution Certipur®, Cat.No. 109017, concentration 1000 mg/l TOC, can be used after diluting accordingly.

TOC

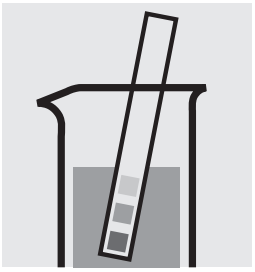
Total Organic Carbon

114879

Cell Test

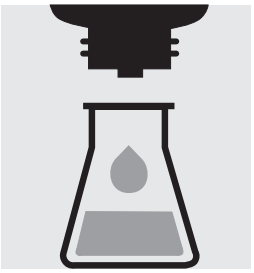
Measuring range: 50 – 800 mg/l TOC

Removal of inorganic bound carbon (TIC):

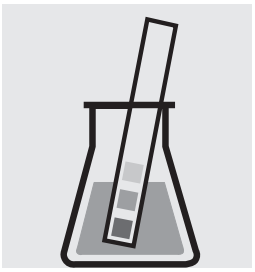


Check the pH of the sample, specified range: pH 2– 12.
If required, add dilute sulfuric acid drop by drop to adjust the pH.

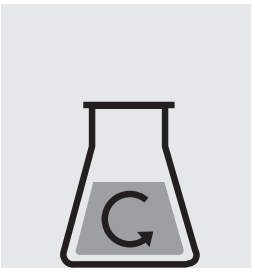
Pipette 1.0 ml of the sample and 9.0 ml of distilled water (Water for chromatography LiChrosolv®, Cat.No. 115333, is recommended) into a suitable glass vessel.



Add 2 drops of **TOC-1K** and mix.



Check the pH, specified range pH < 2.5

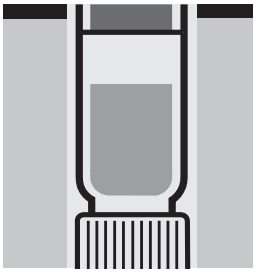


Stir for 10 minutes.

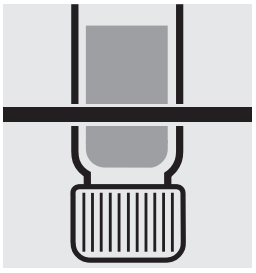
Preparation of measurement sample:

Pipette 3.0 ml of stirred sample into a reaction cell.

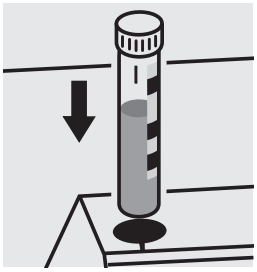
Add 1 level grey microspoon of **TOC-2K**. **Immediately** close the cell tightly with an **aluminium cap** (Cat.No. 173500).



Heat the cell, standing on its head, at 120 °C in the thermoreactor for 2 hours.



Remove the cell from the thermoreactor and let it, **standing on its head**, to cool for 1 hour.



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) a TOC standard solution Certipur®, Cat.No. 109017, concentration 1000 mg/l TOC, can be used after diluting accordingly.

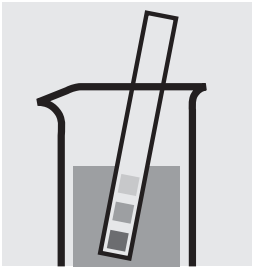
Total Hardness

100961

Determination of total hardness

Cell Test

Measuring range:	5 – 215 mg/l Ca 0.7 – 30.1 °d 0.9 – 37.6 °e 1.2 – 53.7 °f	**Measuring range:**	7 – 301 mg/l CaO 12 – 537 mg/l $CaCO_3$ Expression of results also possible in mmol/l and also in mg/l Mg .

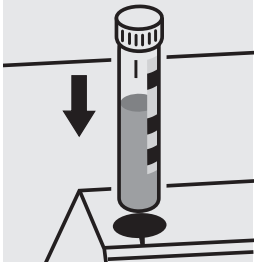


Check the pH of the sample, specified range: pH 3 – 9.
If required, add dilute sodium hydroxide solution or hydrochloric acid drop by drop to adjust the pH.

Pipette 1.0 ml of the sample into a reaction cell, close with the screw cap, and mix.

Add 1.0 ml of **H-1K** with pipette, close the cell with the screw cap, and mix.

Reaction time:
3 minutes



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) a freshly prepared standard solution can be used (see section “Standard solutions”).

Total Hardness

Differentiation between Ca- and Mg-hardness

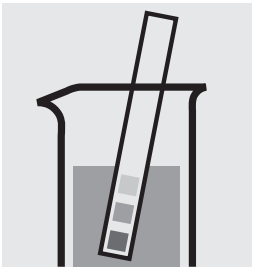
100961

Cell Test

Measuring	0.12 – 5.36	mmol/l
range:	0.7 – 30.1	°d
	0.9 – 37.6	°e
	1.2 – 53.7	°f

Differentiation possible only in mmol/l.

A differentiation between calcium- and magnesium-hardness can be performed on the photometer. Prior to measuring, select the differentiation measurement and choose the corresponding citation form.

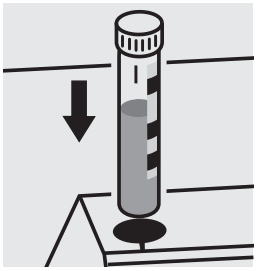


Check the pH of the sample, specified range: pH 3 – 9.
If required, add dilute sodium hydroxide solution or hydrochloric acid drop by drop to adjust the pH.

Pipette 1.0 ml of the sample into a reaction cell, close with the screw cap, and mix.

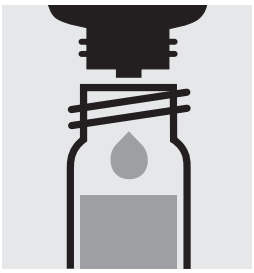
Add 1.0 ml of **H-1K** with pipette, close the cell with the screw cap, and mix.

Reaction time:
3 minutes

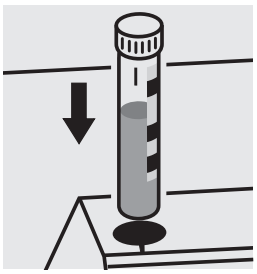


Place the cell into the cell compartment. Align the mark on the cell with that on the photometer
= Result total hardness

Press enter, remove the cell.



Add 3 drops of **H-2K** to the already measured cell, close the cell with the screw cap, and mix.

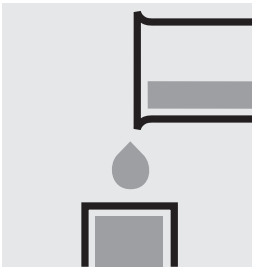


Place the cell into the cell compartment. Align the mark on the cell with that on the photometer
= Result magnesium
= Result calcium

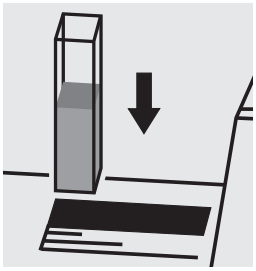
Turbidity

analogous to **EN ISO 7027**

Measuring range:	1 – 100 FAU	550 nm	50-mm cell



Transfer the sample into a cell.



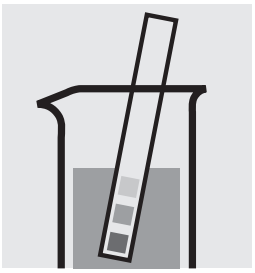
Place the cell into the cell compartment, select method No. **177**.

Volatile Organic Acids

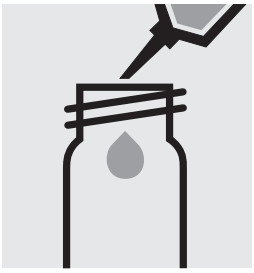
101763

Cell Test

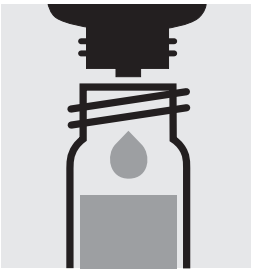
Measuring range:	50 – 3000 mg/l volatile organic acid (calculated as acetic acid)



Check the pH of the sample, specified range: pH 2– 12.

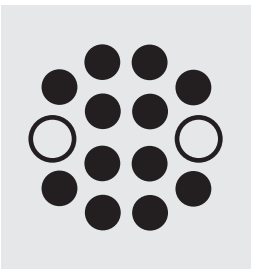


Pipette 0.75 ml of **OA-1** into a round cell.

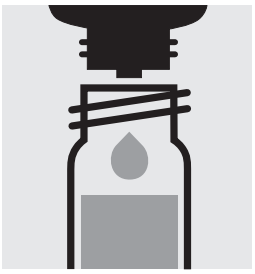


Add 2 drops of **OA-2**.

Add 0.50 ml of the sample with pipette, close with the screw cap, and mix.



Heat the cell in the thermoreactor at 100 °C for 10 minutes. Then cool to room temperature under running water.



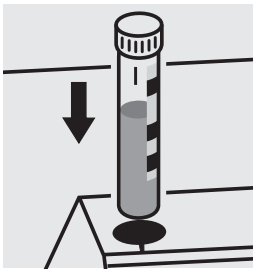
Add 5 drops of **OA-3**.

Add 0.50 ml of **OA-4** with pipette, close the cell with the screw cap, and mix.

Reaction time: 3 minutes

Add 5.0 ml of **OA-5** with pipette, close the cell with the screw cap, and shake vigorously.

Reaction time: 10 minutes



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

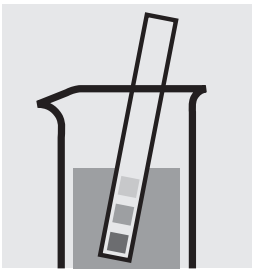
To check the measurement system (test reagents, measurement device, and handling) a standard solution must be prepared from sodium acetate anhydrous, Cat.No. 106268 (see section “Standard solutions”).

Volatile Organic Acids

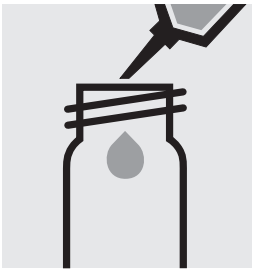
101749

Cell Test

Measuring	50 – 3000 mg/l volatile organic acid	(calculated as acetic acid)
range:	71 – 4401 mg/l volatile organic acid	(calculated as butyric acid)

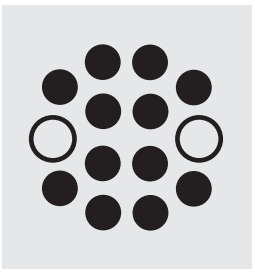


Check the pH of the sample, specified range: pH 2– 12.



Pipette 0.50 ml of **OA-1** into a round cell.

Add 0.50 ml of the sample with pipette, close with the screw cap, and mix.



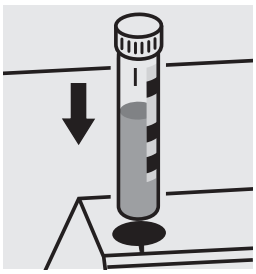
Heat the cell in the thermoreactor at 100 °C for 15 minutes. Then cool to room temperature under running water.

Add 1.0 ml of **OA-2** with pipette.

Add 1.0 ml of **OA-3** with pipette, close the cell with the screw cap, and mix.

Add 1.0 ml of **OA-4** with pipette, close the cell with the screw cap, and shake vigorously.

Reaction time:
1 minute



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

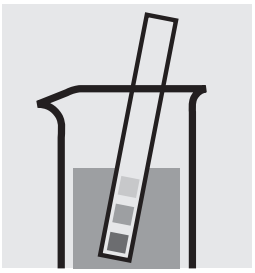
To check the measurement system (test reagents, measurement device, and handling) a standard solution must be prepared from sodium acetate anhydrous, Cat.No. 106268 (see section “Standard solutions”).

Volatile Organic Acids

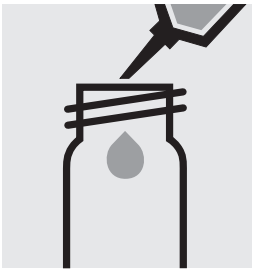
101809

Test

Measuring range:	50 – 3000 mg/l volatile organic acid	(calculated as acetic acid)
	71 – 4401 mg/l volatile organic acid	(calculated as butyric acid)



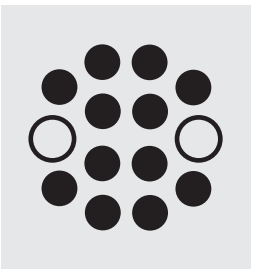
Check the pH of the sample, specified range: pH 2– 12.



Pipette 0.75 ml of **OA-1** into a round cell.

Add 0.50 ml of **OA-2** with pipette.

Add 0.50 ml of the sample with pipette, close with the screw cap, and mix.



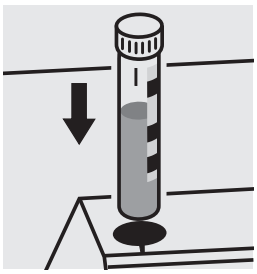
Heat the cell in the thermoreactor at 100 °C for 15 minutes. Then cool to room temperature under running water.

Add 1.0 ml of **OA-3** with pipette.

Add 1.0 ml of **OA-4** with pipette, close the cell with the screw cap, and mix.

Add 1.0 ml of **OA-5** with pipette, close the cell with the screw cap, and shake vigorously.

Reaction time:
1 minute



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Quality assurance:

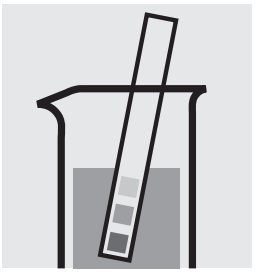
To check the measurement system (test reagents, measurement device, and handling) a standard solution must be prepared from sodium acetate anhydrous, Cat.No. 106268 (see section “Standard solutions”).

Zinc

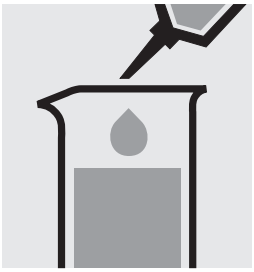
100861

Cell Test

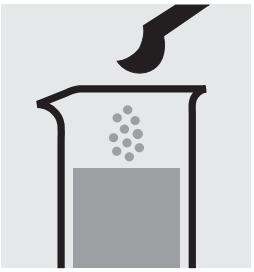
Measuring range:	0.025 – 1.000 mg/l Zn Expression of results also possible in mmol/l.



Check the pH of the sample, specified range: pH 1– 7.
If required, add dilute sodium hydroxide solution or hydrochloric acid drop by drop to adjust the pH.



Pipette 10 ml of sample into a glass vessel.



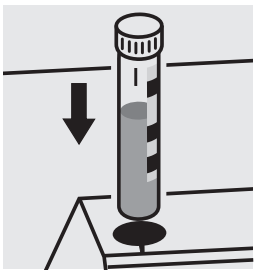
Add 1 level green microspoon of **Zn-1K** and shake to dissolve the solid substance: **sample-reagent mixture**.

Pipette 0.50 ml of **Zn-2K** into a reaction cell, close with the screw cap, and mix.

Add 2.0 ml of the **sample-reagent mixture** with pipette, close the cell with the screw cap, and mix.

Add 5 drops of **Zn-3K**, close the cell with the screw cap, and mix.

Reaction time:
15 minutes



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Important:

For the determination of **total zinc** a pretreatment with Crack Set 10C, Cat.No. 114688, or Crack Set 10, Cat.No. 114687, and thermoreactor is necessary.

Result can be expressed as sum of zinc (Σ Zn).

Quality assurance:

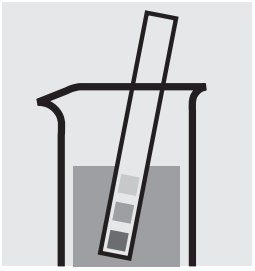
To check the measurement system (test reagents, measurement device, and handling) ready-for-use zinc standard solution Certipur®, Cat.No. 119806, concentration 1000 mg/l Zn, can be used after diluting accordingly.

Zinc

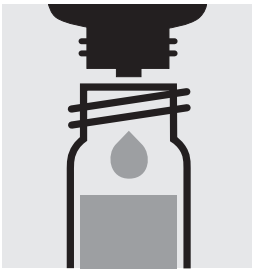
114566

Cell Test

Measuring range:	0.20 – 5.00 mg/l Zn Expression of results also possible in mmol/l.

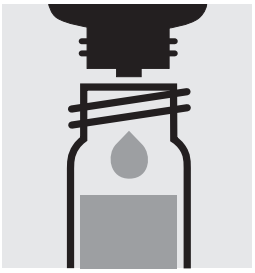


Check the pH of the sample, specified range: pH 3 – 10.
If required, add dilute sodium hydroxide solution or hydrochloric acid drop by drop to adjust the pH.



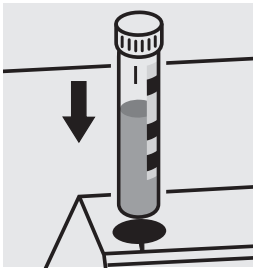
Add 5 drops of **Zn-1K** into a reaction cell, close with the screw cap, and mix.

Add 0.50 ml of the sample with pipette, close the cell with the screw cap, and mix.



Add 5 drops of **Zn-2K**, close the cell with the screw cap, and mix.

Reaction time: 15 minutes



Place the cell into the cell compartment. Align the mark on the cell with that on the photometer.

Important:

For the determination of **total zinc** a pretreatment with Crack Set 10C, Cat.No. 114688, or Crack Set 10, Cat.No. 114687, and thermoreactor is necessary.

Result can be expressed as sum of zinc (Σ Zn).

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) we recommended to use Spectroquant® CombiCheck 40, Cat.No. 114692.

Ready-for-use zinc standard solution Certipur®, Cat.No. 119806, concentration 1000 mg/l Zn, can also be used after diluting accordingly.

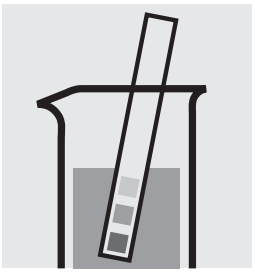
To check for sample-dependent effects the use of addition solutions (e.g. in CombiCheck 40) is highly recommended.

Zinc

114832

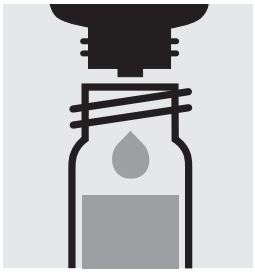
Test

Measuring range:	0.05 – 2.50 mg/l Zn Expression of results also possible in mmol/l.	10-mm cell



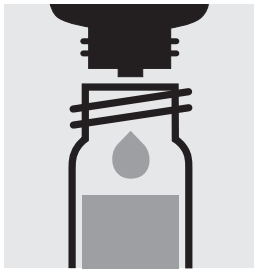
Check the pH of the sample, specified range: pH 4– 10.
If required, add dilute sodium hydroxide solution or hydrochloric acid drop by drop to adjust the pH.

Pipette 5.0 ml of the sample into a test tube with screw cap.



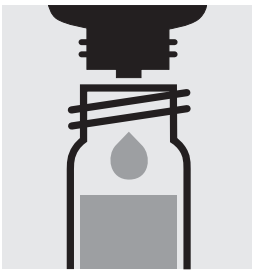
Add 5 drops of **Zn-1**, close the test tube with the screw cap, and mix.

Check the pH, specified range:
pH 12 – 13.
If required, add dilute sodium hydroxide solution drop by drop to adjust the pH.



Add 2 drops of **Zn-2**, close the test tube with the screw cap, and mix.

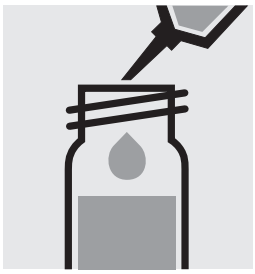
Add 5 drops of **Zn-3**, close the test tube with the screw cap, and mix.



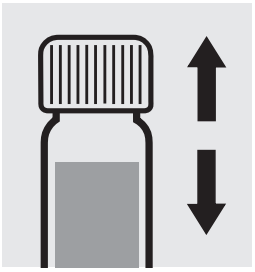
Add 3 drops of **Zn-4**, close the test tube with the screw cap, and mix.

Reaction time:
3 minutes

Add 1 level grey micro-spoon of **Zn-5**, close the test tube with the screw cap, and dissolve the solid substance.

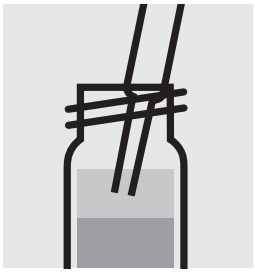


Add 5.0 ml of **Zn-6** (Cat.No. 106146, Isobutyl-methylketone) with pipette and close the test tube with the screw cap.

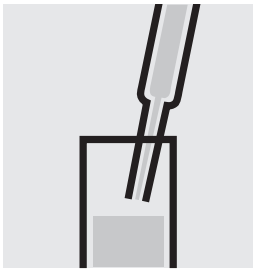


Shake the tube vigorously for 30 seconds.

Leave to stand for 2 minutes.

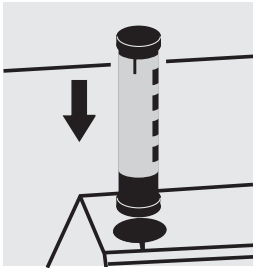


Aspirate the clear upper phase from the tube with pipette.

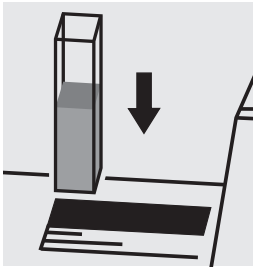


Transfer the solution into a cell.

Leave to stand for 3 minutes.



Select method with AutoSelector.



Place the cell into the cell compartment.

Important:

For the determination of **total zinc** a pretreatment with Crack Set 10C, Cat.No. 114688, or Crack Set 10, Cat.No. 114687, and thermoreactor is necessary.

Result can be expressed as sum of zinc (Σ Zn).

Quality assurance:

To check the measurement system (test reagents, measurement device, and handling) ready-for-use zinc standard solution Certipur®, Cat.No. 119806, concentration 1000 mg/l Zn, can be used after diluting accordingly.

Suitability of Test Kits for Testing Seawater and Tolerance Limits of Neutral Salts

Test kit	Cat. No.	Seawater	Limit of tolerance, salts in %		
			NaCl	$NaNO_3$	Na_2SO_4
Acid Capacity Cell Test	101758	no	–	–	–
Aluminium Cell Test	100594	yes	20	20	20
Aluminium Test	114825	yes	10	20	20
Ammonium Cell Test	114739	no	5	5	5
Ammonium Cell Test	114558	yes	20	10	15
Ammonium Cell Test	114544	yes	20	15	20
Ammonium Cell Test	114559	yes	20	20	20
Ammonium Test	114752	no [1]	10	10	20
Ammonium Test	100683	yes	20	20	20
AOX Cell Test	100675	no	0.4	20	20
Arsenic Test	101747	no	10	10	10
BOD Cell Test	100687	yes	20	20	20
Boron Cell Test	100826	yes	10	20	20
Boron Test	114839	no	20	5	20
Bromine Test	100605	no	10	10	10
Cadmium Cell Test	114834	no	1	10	1
Cadmium Test	101745	no	1	10	1
Calcium Cell Test	100858	no	2	2	1
Calcium Test	114815	yes	20	20	10
Calcium Test	100049	no	–	–	–
Chloride Cell Test	114730	yes	–	20	1
Chloride Test	114897	yes	–	10	0.1
Chloride Cell Test	101804	no	–	0.5	0.05
Chloride Test	101807	no	–	0.5	0.05
Chlorine Cell Test	100595	no	10	10	10
Chlorine Cell Test	100597	no	10	10	10
Chlorine Test	100598	no	10	10	10
Chlorine Test	100602	no	10	10	10
Chlorine Test	100599	no	10	10	10
Chlorine reagents (liquid) (free and total)	100086/100087/ 100088	no	10	10	10
Chlorine dioxide Test	100608	no	10	10	10
Chromate Cell Test (chromium(VI))	114552	yes	10	10	10
Chromate Cell Test (chromium total)	114552	no	1	10	10
Chromate Test	114758	yes	10	10	10
COD Cell Test	114560	no	0.4	10	10
COD Cell Test	101796	no	0.4	10	10
COD Cell Test	114540	no	0.4	10	10
COD Cell Test	114895	no	0.4	10	10
COD Cell Test	114690	no	0.4	20	20
COD Cell Test	114541	no	0.4	10	10
COD Cell Test	114691	no	0.4	20	20
COD Cell Test	114555	no	1.0	10	10
COD Cell Test	101797	no	10	20	20
COD Cell Test (Hg free)	109772	no	0	10	10
COD Cell Test (Hg free)	109773	no	0	10	10
COD Cell Test (seawater)	117058	yes	35	10	10
COD Cell Test (seawater)	117059	yes	35	10	10
Copper Cell Test	114553	yes	15	15	15
Copper Test	114767	yes	15	15	15
Cyanide Cell Test	102531	no	10	10	10
Cyanide Cell Test	114561	no	10	10	10
Cyanide Test	109701	no	10	10	10
Cyanuric Acid Test	119253	yes	–	–	–
Fluoride Cell Test	114557	no	10	10	10
Fluoride Cell Test	100809	no	10	10	10
Fluoride Test	114598	yes	20	20	20
Fluoride Test	100822	yes [2]	0.05	0.05	0.001
Formaldehyde Cell Test	114500	no	5	0	10
Formaldehyde Test	114678	no	5	0	10
Gold Test	114821	yes	10	20	5
Hardness, see Total Hardness Cell Test					
Hydrazine Test	109711	no	20	5	2
Hydrogenperoxide Cell Test	114731	yes	20	20	20
Hydrogenperoxide Test	118789	no	0.1	1	5
Iodine Test	100606	no	10	10	10
Iron Cell Test	114549	yes	20	20	20
Iron Cell Test	114896	no	5	5	5

[1] This test kit is also suitable for testing seawater after the addition of sodium hydroxide solution (see package insert).
[2] distill beforehand analogous APHA 4500-F^- B

Suitability of Test Kits for Testing Seawater and Tolerance Limits of Neutral Salts

Test kit	Cat. No.	Seawater	Limit of tolerance, salts in %		
			NaCl	$NaNO_3$	Na_2SO_4
Iron Test	114761	yes	20	20	20
Iron Test	100796	yes	20	20	20
Lead Cell Test	114833	no	20	20	1
Lead Cell Test	109717	no	20	5	15
Magnesium Cell Test	100815	yes	2	2	1
Manganese Cell Test	100816	no	20	20	20
Manganese Test	101739	no	20	25	5
Manganese Test	114770	yes	20	20	20
Manganese Test	101846	no	20	25	5
Molybdenum Cell Test	100860	no	20	20	5
Molybdenum Test	119252	no	–	–	–
Monochloramine Test	101632	no	10	10	20
Nickel Cell Test	114554	no	20	20	20
Nickel Test	114785	no	20	20	20
Nitrate Cell Test	114542	no	0.4	–	20
Nitrate Cell Test	114563	no	0.2	–	20
Nitrate Cell Test	114764	no	0.5	–	20
Nitrate Cell Test	100614	no	2	–	20
Nitrate Test	114773	no	0.4	–	20
Nitrate Test	109713	no	0.2	–	20
Nitrate Cell Test (seawater)	114556	yes	20	–	20
Nitrate Test (seawater)	114942	yes	20	–	20
Nitrate Test	101842	no	0.001	–	0.001
Nitrite Cell Test	114547	yes	20	20	15
Nitrite Cell Test	100609	yes	20	20	15
Nitrite Test	114776	yes	20	20	15
Nitrogen (total) Cell Test	114537	no	0.5	–	10
Nitrogen (total) Cell Test	100613	no	0.2	–	10
Nitrogen (total) Cell Test	114763	no	2	–	20
Oxygen Cell Test	114694	no	10	5	1
Oxygen Scavengers Test	119251	no	–	–	–
Ozone Test	100607	no	10	10	10
pH Cell Test	101744	yes	–	–	–
Phenol Cell Test	114551	yes	20	20	15
Phenol Test	100856	yes	20	20	20
Phosphate Cell Test	100474	yes	5	10	10
Phosphate Cell Test (orthophosphates)	114543	yes	5	10	10
Phosphate Cell Test (phosphorus total)	114543	no	1	10	10
Phosphate Cell Test	100475	yes	20	20	20
Phosphate Cell Test (orthophosphates)	114729	yes	20	20	20
Phosphate Cell Test (phosphorus total)	114729	yes	5	20	20
Phosphate Cell Test	100616	yes	20	20	20
Phosphate Cell Test (orthophosphates)	100673	yes	20	20	20
Phosphate Cell Test (phosphorus total)	100673	yes	20	20	20
Phosphate Test	114848	yes	5	10	10
Phosphate Test	100798	yes	15	20	10
Phosphate Cell Test	114546	yes	20	20	20
Phosphate Test	114842	yes	20	20	20
Potassium Cell Test	114562	yes	20	20	20
Potassium Cell Test	100615	yes	20	20	20
Residual Hardness Cell Test	114683	no	0.01	0.01	0.01
Silicate (Silicic Acid) Test	114794	yes	5	10	5
Silicate (Silicic Acid) Test	100857	no	5	10	2.5
Silicate (Silicic Acid) Test	101813	no	0.5	1	0.2
Silver Test	114831	no	0	1	5
Sodium Cell Test	100885	no	–	10	1
Sulfate Cell Test	102532	no	2	0.007	–
Sulfate Cell Test	114548	yes	10	0.1	–
Sulfate Cell Test	100617	yes	10	0.1	–
Sulfate Cell Test	114564	yes	10	0.5	–
Sulfate Test	114791	no	0.2	0.2	–
Sulfate Test	101812	no	2	0.007	–
Sulfate Test	102537	yes	10	0.015	–
Sulfide Test	114779	no	0.5	1	1
Sulfite Cell Test	114394	no	20	20	20
Sulfite Test	101746	no	20	20	20
Surfactants (anionic) Cell Test	114697	no	0.1	0.01	10
Surfactants (anionic) Cell Test	102552	no	0.1	0.01	10

Suitability of Test Kits for Testing Seawater and Tolerance Limits of Neutral Salts

Test kit	Cat. No.	Seawater	Limit of tolerance, salts in %		
			NaCl	$NaNO_3$	Na_2SO_4
Surfactants (cationic) Cell Test	101764	no	0.1	0.1	20
Surfactants (nonionic) Cell Test	101787	no	2	5	2
Tin Cell Test	114622	yes	20	20	20
TOC Cell Test	114878	no	0.5	10	10
TOC Cell Test	114879	no	5	20	20
Total Hardness Cell Test	100961	no	2	2	1
Volatile Organic Acids Cell Test	101763	no	20	20	10
Volatile Organic Acids Cell Test	101749	no	20	20	10
Volatile Organic Acids Test	101809	no	20	20	10
Zinc Cell Test	100861	no	20	20	1
Zinc Cell Test	114566	no	10	10	10
Zinc Test	114832	no	5	15	15

Spectroquant® CombiCheck and Standard Solutions

Test kit, Cat. No. or method	Evaluation as	CombiCheck, Cat. No.	Confidence interval: Spec. value for the standard	Confidence interval: max. working tolerance	Diluted and ready-to-use standard solutions, CRM: Cat. No.	Diluted and ready-to-use standard solutions, CRM: concentration	Diluted and ready-to-use standard solutions, CRM: expanded measurement uncertainty	Ready-to-use standard solution, Cat. No.
Acid Capacity Cell Test, 101758	OH	–	5.00 mmol/l*	± 0.50 mmol/l	–			see prep. instr.
ADMI (only Pharo)		–	50*		–			100246
ADMI (only Pharo)		–	250*		–			100246
Aluminium Cell Test, 100594	Al	–	0.25 mg/l*	± 0.03 mg/l	–			119770
Aluminium Test, 114825	Al	CombiCheck 40, 114692	0.75 mg/l	± 0.08 mg/l	–			119770
Ammonium Cell Test, 114739	NH_4-N	CombiCheck 50, 114695	1.00 mg/l	± 0.10 mg/l	125022	0.400 mg/l	± 0.012 mg/l	
					125023	1.00 mg/l	± 0.04 mg/l	119812
Ammonium Cell Test, 114558	NH_4-N	CombiCheck 10, 114676	4.00 mg/l	± 0.30 mg/l	125022	0.400 mg/l	± 0.012 mg/l	
					125023	1.00 mg/l	± 0.04 mg/l	
					125024	2.00 mg/l	± 0.07 mg/l	
					125025	6.00 mg/l	± 0.13 mg/l	119812
Ammonium Cell Test, 114544	NH_4-N	CombiCheck 20, 114675	12.0 mg/l	± 1.0 mg/l	125023	1.00 mg/l	± 0.04 mg/l	
					125024	2.00 mg/l	± 0.07 mg/l	
					125025	6.00 mg/l	± 0.13 mg/l	
					125026	12.0 mg/l	± 0.4 mg/l	119812
Ammonium Cell Test, 114559	NH_4-N	CombiCheck 70, 114689	50.0 mg/l	± 5.0 mg/l	125025	6.00 mg/l	± 0.13 mg/l	
					125026	12.0 mg/l	± 0.4 mg/l	
					125027	50.0 mg/l	± 1.2 mg/l	119812
Ammonium Test, 114752	NH_4-N	CombiCheck 50, 114695	1.00 mg/l	± 0.10 mg/l	125022	0.400 mg/l	± 0.012 mg/l	
					125023	1.00 mg/l	± 0.04 mg/l	
					125024	2.00 mg/l	± 0.07 mg/l	119812
Ammonium Test, 100683	NH_4-N	CombiCheck 70, 114689	50.0 mg/l	± 5.0 mg/l	125025	6.00 mg/l	± 0.13 mg/l	
					125026	12.0 mg/l	± 0.4 mg/l	
					125027	50.0 mg/l	± 1.2 mg/l	119812
AOX Cell Test, 100675	AOX	–	1.00 mg/l*	± 0.10 mg/l	–			100680
Arsenic Test, 101747	As	–	0.050 mg/l*	± 0.005 mg/l	–			119773
BOD Cell Test, 100687	O_2	–	210 mg/l	± 20 mg/l	–			100718
Boron Cell Test, 100826	B	–	1.00 mg/l*	± 0.15 mg/l	–			119500
Boron Test, 114839	B	–	0.400 mg/l*	± 0.040 mg/l	–			119500
Bromine Test, 100605	Br_2	–	5,00 mg/l*	± 0,50 mg/l	–			see prep. instr.
Cadmium Cell Test, 114834	Cd	CombiCheck 30, 114677	0.500 mg/l	± 0.060 mg/l	–			119777
Cadmium Test, 101745	Cd	–	0.250 mg/l	± 0.010 mg/l	–			119777
Calcium Cell Test, 100858	Ca	–	75 mg/l*	± 7 mg/l	–			see prep. instr.
Calcium Test, 114815	Ca	–	80 mg/l*	± 8 mg/l	–			119778
Calcium Test, 100049 (only Pharo)	Ca	–	2.00 mg/l*	± 0.20 mg/l	–			119778
Chloride Cell Test, 114730	Cl	CombiCheck 20, 114675	60 mg/l	± 10 mg/l				
		CombiCheck 10, 114676	25 mg/l	± 6 mg/l	–			119897
Chloride Test, 114897	Cl	CombiCheck 60, 114696	125 mg/l	± 13 mg/l				
		–	12.5 mg/l*	± 0.13 mg/l	–			119897
Chloride Cell Test, 101804	Cl	–	7.5 mg/l*	± 0.8 mg/l	–			119897
Chloride Test, 101807	Cl	–	2.50 mg/l*	± 0.25 mg/l	–			119897
Chlorine Cell Test, 100595	Cl_2	–	3.00 mg/l*	± 0.30 mg/l	–			see prep. instr.
Chlorine Cell Test, 100597	Cl_2	–	3.00 mg/l*	± 0.30 mg/l	–			see prep. instr.
Chlorine Test, 100598	Cl_2	–	3.00 mg/l*	± 0.30 mg/l	–			see prep. instr.
Chlorine Test, 100602	Cl_2	–	3.00 mg/l*	± 0.30 mg/l	–			see prep. instr.
Chlorine Test, 100599	Cl_2	–	3.00 mg/l*	± 0.30 mg/l	–			see prep. instr.
Chlorine Cell Test (liquid reagent), 00086/00087	Cl_2	–	3.00 mg/l*	± 0.30 mg/l	–			see prep. instr.
Chlorine Test (liquid reagent), 100086/100087	Cl_2	–	0.500 mg/l*	± 0.050 mg/l	–			see prep. instr.
Chlorine Cell Test (liquid reagent), 100086/100087/100088	Cl_2	–	3.00 mg/l*	± 0.30 mg/l	–			see prep. instr.
Chlorine Test (liquid reagent), 100086/100087/100088	Cl_2	–	0.500 mg/l*	± 0.050 mg/l	–			see prep. instr.
Chlorine Dioxide Test, 100608	ClO_2	–	5.00 mg/l*	± 0.50 mg/l	–			see prep. instr.
Chromate Cell Test, 114552	Cr	–	1.00 mg/l*	± 0.10 mg/l	–			119780
Chromate Test, 114758	Cr	–	1.00 mg/l*	± 0.10 mg/l	–			119780
COD Cell Test, 114560	COD	CombiCheck 50, 114695	20.0 mg/l	± 4.0 mg/l	125028	20.0 mg/l	± 0.7 mg/l	see prep. instr.
COD Cell Test, 101796	COD	CombiCheck 50, 114695	20.0 mg/l	± 2.0 mg/l	125028	20.0 mg/l	± 0.7 mg/l	see prep. instr.
COD Cell Test, 114540	COD	CombiCheck 10, 114676	80 mg/l	± 12 mg/l	125029	100 mg/l	± 3 mg/l	see prep. instr.
COD Cell Test, 114895	COD	CombiCheck 60, 114696	250 mg/l	± 20 mg/l	125029	100 mg/l	± 3 mg/l	
					125030	200 mg/l	± 4 mg/l	see prep. instr.
COD Cell Test, 114690	COD	CombiCheck 60, 114696	250 mg/l	± 25 mg/l	125029	100 mg/l	± 3 mg/l	
					125030	200 mg/l	± 4 mg/l	
					125031	400 mg/l	± 5 mg/l	see prep. instr.
COD Cell Test, 114541	COD	CombiCheck 20, 114675	750 mg/l	± 75 mg/l	125029	100 mg/l	± 3 mg/l	
					125030	200 mg/l	± 4 mg/l	
					125031	400 mg/l	± 5 mg/l	
					125032	1000 mg/l	± 11 mg/l	see prep. instr.

* Self prepared, recommended concentration

Spectroquant® CombiCheck and Standard Solutions

Test kit, Cat. No. or method	Evaluation as	CombiCheck, Cat. No.	Confidence interval		Diluted and ready-to-use standard solutions, CRM			Ready-to-use standard solution, Cat. No.
			Spec. value for the standard	max. working tolerance	Cat. No.	concentration	expanded measurement uncertainty	
COD Cell Test, 114691	COD	CombiCheck 80, 114738	1500 mg/l	± 150 mg/l	125031	400 mg/l	± 5 mg/l	
					125032	1000 mg/l	± 11 mg/l	
					125033	2000 mg/l	± 32 mg/l	see prep. instr.
COD Cell Test, 114555	COD	CombiCheck 70, 114689	5000 mg/l	± 400 mg/l	125032	1000 mg/l	± 11 mg/l	
					125033	2000 mg/l	± 32 mg/l	
					125034	8000 mg/l	± 68 mg/l	see prep. instr.
COD Cell Test, 101797	COD	–	50000 mg/l*	± 5000 mg/l	125034	8000 mg/l	± 68 mg/l	
					125035	50 000 mg/l	± 894 mg/l	see prep. instr.
COD Cell Test, 109772	COD	–	80 mg/l*	± 12 mg/l	125028	20.0 mg/l	± 0.7 mg/l	
					125029	100 mg/l	± 3 mg/l	see prep. instr.
COD Cell Test, 109773	COD	–	750 mg/l*	± 75 mg/l	125029	100 mg/l	± 3 mg/l	
					125030	200 mg/l	± 4 mg/l	
					125031	400 mg/l	± 5 mg/l	
					125032	1000 mg/l	± 11 mg/l	see prep. instr.
COD Cell Test, 117058	COD	–	30.0 mg/l*	± 3.0 mg/l	–			see prep. instr.
COD Cell Test, 117059	COD	–	1500 mg/l*	± 150 mg/l	–			see prep. instr.
Color Hazen	Pt/Co (Hazen)	–	250 mg/l*		–			100246
Color Hazen	Pt/Co (Hazen)	–	500 mg/l		–			100246
Copper Cell Test, 114553	Cu	CombiCheck 30, 114677	2.00 mg/l	± 0.20 mg/l	–			119786
Copper Test, 114767	Cu	CombiCheck 30, 114677	2.00 mg/l	± 0.20 mg/l	–			119786
Cyanide Cell Test, 102531	CN	–	0.250 mg/l*	± 0.030 mg/l	–			119533
Cyanide Cell Test, 114561	CN	–	0.250 mg/l*	± 0.030 mg/l	–			119533
Cyanide Test, 109701	CN	–	0.250 mg/l*	± 0.030 mg/l	–			119533
Cyanuric Acid Test, 119253	Cyan Acid	–	80 mg/l*	± 10 mg/l	–			see prep. instr.
Fluoride Cell Test, 114557	F	–	0.75 mg/l*	± 0.08 mg/l	–			119814
Fluoride Cell Test, 100809	F	–	0.75 mg/l*	± 0.08 mg/l	–			119814
Fluoride Test, 114598	F	–	1.00 mg/l*	± 0.15 mg/l				
			10.0 mg/l*	± 1.2 mg/l	–			119814
Fluoride Test, 100822	F	–	1.00 mg/l*	± 0.15 mg/l	–			119814
Formaldehyde Cell Test, 114500	HCHO	–	5.00 mg/l*	± 0.50 mg/l	–			see prep. instr.
Formaldehyde Test, 114678	HCHO	–	4.50 mg/l*	± 0.50 mg/l	–			see prep. instr.
Gold Test, 114821	Au	–	6.0 mg/l*	± 0.6 mg/l	–			170216
Hardness, see Total Hardness Cell Test								
Hydrazine Test, 109711	N_2H_4	–	1.00 mg/l*	± 0.10 mg/l	–			see prep. instr.
Hydrogenperoxide Cell Test, 114731	H_2O_2	–	10.0 mg/l*	± 1.0 mg/l	–			see prep. instr.
Hydrogenperoxide Test, 118789	H_2O_2	–	2.00 mg/l*	± 0.20 mg/l	–			see prep. instr.
Iodine Test, 100606	I_2	–	5.00 mg/l*	± 0.50 mg/l	–			see prep. instr.
Iron Cell Test, 114549	Fe	CombiCheck 30, 114677	1.00 mg/l	± 0.15 mg/l	–			119781
Iron Cell Test, 114896	Fe	–	25.0 mg/l*	± 2.5 mg/l	–			119781
Iron Test, 114761	Fe	CombiCheck 30, 114677	1.00 mg/l	± 0.15 mg/l	–			119781
Iron Test, 100796	Fe	CombiCheck 30, 114677	1.00 mg/l	± 0.15 mg/l	–			119781
Lead Cell Test, 114833	Pb	CombiCheck 40, 114692	2.00 mg/l	± 0.20 mg/l	–			119776
Lead Test, 109717	Pb	CombiCheck 40, 114692	2.00 mg/l	± 0.20 mg/l	–			119776
Magnesium Cell Test, 100815	Mg	–	40.0 mg/l*	± 4.0 mg/l	–			see prep. instr.
Manganese Cell Test, 100816	Mn	CombiCheck 30, 114677	1.00 mg/l	± 0.15 mg/l	–			119789
Manganese Test, 101739	Mn	–	1.00 mg/l*	± 0.10 mg/l	–			119789
Manganese Test, 114770	Mn	CombiCheck 30, 114677	1.00 mg/l	± 0.15 mg/l	–			119789
Manganese Test, 101846	Mn	–	1.00 mg/l*	± 0.10 mg/l	–			119789
Molybdenum Cell Test, 100860	Mo	–	0.50 mg/l*	± 0.05 mg/l	–			170227
Molybdenum Test, 119252	Mo	–	25.0 mg/l*	± 2.5 mg/l	–			170227
Monochloramine Test, 101632	Cl_2	–	5.00 mg/l*	± 0.50 mg/l	–			see prep. instr.
Nickel Cell Test, 114554	Ni	CombiCheck 40, 114692	2.00 mg/l	± 0.20 mg/l	–			109989
Nickel Test, 114785	Ni	CombiCheck 40, 114692	2.00 mg/l	± 0.20 mg/l	–			109989
Nitrate Cell Test, 114542	NO_3-N	CombiCheck 20, 114675	9.0 mg/l	± 0.9 mg/l	125037	2.50 mg/l	± 0.06 mg/l	
					125038	15.0 mg/l	± 0.4 mg/l	119811
Nitrate Cell Test, 114563	NO_3-N	CombiCheck 20, 114675	9.0 mg/l	± 0.9 mg/l	125037	2.50 mg/l	± 0.06 mg/l	
					125038	15.0 mg/l	± 0.4 mg/l	119811
Nitrate Cell Test, 114764	NO_3-N	CombiCheck 80, 114738	25.0 mg/l	± 2.5 mg/l	125037	2.50 mg/l	± 0.06 mg/l	
					125038	15.0 mg/l	± 0.4 mg/l	
					125039	40.0 mg/l	± 1.0 mg/l	119811
Nitrat Cell Test, 100614	NO_3-N	–	100 mg/l*	± 10 mg/l	125039	40.0 mg/l	± 1.0 mg/l	
					125040	200 mg/l	± 5 mg/l	119811
Nitrate Test, 114773	NO_3-N	CombiCheck 20, 114675	9.0 mg/l	± 0.9 mg/l	125036	0.500 mg/l	± 0.05 mg/l	
					125037	2.50 mg/l	± 0.06 mg/l	
					125038	15.0 mg/l	± 0.4 mg/l	119811

* Self prepared, recommended concentration

Spectroquant® CombiCheck and Standard Solutions

Test kit, Cat. No. or method	Evaluation as	CombiCheck, Cat. No.	Confidence interval: Spec. value for the standard	Confidence interval: max. working tolerance	Diluted and ready-to-use standard solutions, CRM: Cat. No.	concentration	expanded measurement uncertainty	Ready-to-use standard solution, Cat. No.
Nitrate Test, 109713	NO_3-N	CombiCheck 20, 114675	9.0 mg/l	± 0.9 mg/l	125036	0.500 mg/l	± 0.05 mg/l	
					125037	2.50 mg/l	± 0.06 mg/l	
					125038	15.0 mg/l	± 0.4 mg/l	119811
Nitrate Cell Test, 114556	NO_3-N	CombiCheck 10, 114676	2.50 mg/l	± 0.25 mg/l	125036	0.500 mg/l	± 0.05 mg/l	
					125037	2.50 mg/l	± 0.06 mg/l	119811
Nitrate Test, 114942	NO_3-N	CombiCheck 20, 114675	9.0 mg/l	± 0.9 mg/l	125036	0.500 mg/l	± 0.05 mg/l	
					125037	2.50 mg/l	± 0.06 mg/l	
					125038	15.0 mg/l	± 0.4 mg/l	119811
Nitrate Test, 101842	NO_3-N	–	10.0 mg/l*	± 1.5 mg/l	–			119811
Nitrite Cell Test, 114547	NO_2-N	–	0.300 mg/l*	± 0.030 mg/l	125041	0.200 mg/l	± 0.009 mg/l	119899
Nitrite Cell Test, 100609	NO_2-N	–	45.0 mg/l*	± 5 mg/l	125042	40.0 mg/l	± 1.3 mg/l	119899
Nitrite Test, 114776	NO_2-N	–	0.50 mg/l*	± 0.05 mg/l	125041	0.200 mg/l	± 0.009 mg/l	119899
Nitrogen (total) Cell Test, 114537	N	CombiCheck 50, 114695	5.0 mg/l	± 0.7 mg/l	125043	2.50 mg/l	± 0.06 mg/l	
					125044	12.0 mg/l	± 0.3 mg/l	see prep. instr.
Nitrogen (total) Cell Test, 100613	N	CombiCheck 50, 114695	5.0 mg/l	± 0.7 mg/l	125043	2.50 mg/l	± 0.06 mg/l	
					125044	12.0 mg/l	± 0.3 mg/l	see prep. instr.
Nitrogen (total) Cell Test, 114763	N	CombiCheck 70, 114689	50 mg/l	± 7 mg/l	125044	12.0 mg/l	± 0.3 mg/l	
					125045	100 mg/l	± 3 mg/l	see prep. instr.
Oxygen Cell Test, 114694	O_2	–	–	± 0.6 mg/l	–			see the website
Oxygen Scavengers Test, 119251	DEHA	–	0.250 mg/l*	± 0.030 mg/l	–			see prep. instr.
Ozone Test, 100607	O_3	–	2.00 mg/l*	± 0.20 mg/l	–			see prep. instr.
pH Cell Test, 101744	pH	–	7.0	± 0.2	–			109407
Phenol Cell Test, 114551	C_6H_5OH	–	1.25 mg/l*	± 0.13 mg/l	–			see prep. instr.
Phenol Test, 100856	C_6H_5OH	–	2.50 mg/l*	± 0.25 mg/l	–			see prep. instr.
Phosphate Cell Test, 100474	PO_4-P	CombiCheck 10, 114676	0.80 mg/l	± 0.08 mg/l	–			119898
Phosphate Cell Test, 114543	PO_4-P	CombiCheck 10, 114676	0.80 mg/l	± 0.08 mg/l	125046	0.400 mg/l P	± 0.016 mg/l	
					125047	4.00 mg/l P	± 0.08 mg/l	119898
Phosphate Cell Test, 100475	PO_4-P	CombiCheck 80, 114738	15.0 mg/l	± 1.0 mg/l				
		CombiCheck 20, 114675	8.0 mg/l	± 0.7 mg/l	–			119898
Phosphate Cell Test, 114729	PO_4-P	CombiCheck 80, 114738	15.0 mg/l	± 1.0 mg/l	125047	4.00 mg/l P	± 0.08 mg/l	
		CombiCheck 20, 114675	8.0 mg/l	± 0.7 mg/l	125048	15.0 mg/l P	± 0.4 mg/l	119898
Phosphat Cell Test, 100616	PO_4-P	–	50.0 mg/l*	± 5.0 mg/l	–			119898
Phosphat Cell Test, 100673	PO_4-P	–	50.0 mg/l*	± 5.0 mg/l	125047	4.00 mg/l P	± 0.08 mg/l	
					125048	15.0 mg/l P	± 0.4 mg/l	
					125049	75.0 mg/l P	± 1.6 mg/l	119898
Phosphate Test, 114848	PO_4-P	CombiCheck 10, 114676	0.80 mg/l	± 0.08 mg/l	–			119898
Phosphate Test, 100798	PO_4-P	–	50.0 mg/l*	± 5.0 mg/l	–			119898
Phosphate Cell Test, 114546	PO_4-P	–	15.0 mg/l*	± 1.0 mg/l	–			119898
Phosphate Test, 114842	PO_4-P	–	15.0 mg/l*	± 1.0 mg/l	–			119898
Potassium Cell Test, 114562	K	–	25.0 mg/l*	± 4.0 mg/l	–			170230
Potassium Cell Test, 100615	K	–	150 mg/l*	± 15 mg/l	–			170230
Residual Hardness Cell Test, 114683	Ca	–	2.50 mg/l*	± 0.30 mg/l	–			119778
Silicate Test, 114794	SiO_2	–	5.00 mg/l*	± 0.50 mg/l				
			0.750 mg/l*	± 0.075 mg/l	–			170236
Silicate Test, 100857	SiO_2	–	50.0 mg/l*	± 5.0 mg/l	–			170236
Silicate Test, 101813	SiO_2	–	0.1000 mg/l*	± 0.0100 mg/l	–			170236
Silver Test, 114831	Ag	–	1.50 mg/l*	± 0.20 mg/l	–			119797
Sodium Cell Test, 100885	Na	–	100 mg/l*	± 10 mg/l	–			see prep. instr.
Sulfate Cell Test, 102532	SO_4	–	25.0 mg/l*	± 3.0 mg/l	–			119813
Sulfate Cell Test, 114548	SO_4	CombiCheck 10, 114676	100 mg/l	± 15 mg/l	125050	40 mg/l	± 6 mg/l	
					125051	125 mg/l	± 6 mg/l	119813
Sulfat Cell Test, 100617	SO_4	CombiCheck 10, 114676	100 mg/l	± 15 mg/l	125051	125 mg/l	± 6 mg/l	
					125052	400 mg/l	± 20 mg/l	119813
Sulfate Cell Test, 114564	SO_4	CombiCheck 20, 114675	500 mg/l	± 75 mg/l	125051	125 mg/l	± 6 mg/l	
					125052	400 mg/l	± 20 mg/l	
					125053	800 mg/l	± 27 mg/l	119813
Sulfate Test, 114791	SO_4	CombiCheck 10, 114676	100 mg/l	± 15 mg/l	125050	40 mg/l	± 6 mg/l	
					125051	125 mg/l	± 6 mg/l	119813
Sulfate Test, 101812	SO_4	–	5.00 mg/l*	± 0.50 mg/l	–			119813
Sulfate Test, 102537	SO_4	CombiCheck 10, 114676	100 mg/l	± 15 mg/l	125050	40 mg/l	± 6 mg/l	
					125051	125 mg/l	± 6 mg/l	119813
Sulfide Test, 114779	S	–	0.75 mg/l*	± 0.08 mg/l	–			see prep. instr.
Sulfite Cell Test, 114394	SO_3	–	12.5 mg/l*	± 1.5 mg/l	–			see prep. instr.
Sulfite Test, 101746	SO_3	–	30.0 mg/l*	± 1.0 mg/l	–			see prep. instr.
Surfactants (anionic) Cell Test, 114697	MBAS	–	1.00 mg/l*	± 0.20 mg/l	–			see prep. instr.
Surfactants (anionic) Cell Test, 102552	MBAS	–	1.00 mg/l*	± 0.20 mg/l	–			see prep. instr.

* Self prepared, recommended concentration

Spectroquant® CombiCheck and Standard Solutions

Test kit, Cat. No. or method	Evaluation as	CombiCheck, Cat. No.	Confidence interval Spec. value for the standard	max. working tolerance	Diluted and ready-to-use standard solutions, CRM Cat. No.	concentration	expanded measurement uncertainty	Ready-to-use standard solution, Cat. No.
Surfactants (cationic) Cell Test, 101764	k-Ten	–	1.00 mg/l*	± 0.10 mg/l	–			see prep. instr.
Surfactants (nonionic) Cell Test, 101787	n-Ten	–	4.00 mg/l*	± 0.40 mg/l	–			see prep. instr.
Tin Cell Test, 114622	Sn	–	1.25 mg/l*	± 0.13 mg/l	–			see prep. instr.
TOC Cell Test, 114878	TOC	–	40.0 mg/l*	± 3.0 mg/l	–			109017
TOC Cell Test, 114879	TOC	–	400 mg/l*	± 30 mg/l	–			109017
Total Hardness Cell Test, 100961	Ca	–	75 mg/l*	± 7 mg/l	–			see prep. instr.
Volatile Organic Acids Cell Test, 101763	HOAc	–	1500 mg/l*	± 80 mg/l	–			see prep. instr.
Volatile Organic Acids Cell Test, 101749	C_3H_7COOH	–	1500 mg/l*	± 80 mg/l	–			see prep. instr.
Volatile Organic Acids Test, 101809	C_3H_7COOH	–	1500 mg/l*	± 80 mg/l	–			see prep. instr.
Zinc Cell Test, 100861	Zn	–	0.500 mg/l*	± 0.050 mg/l	–			119806
Zinc Cell Test, 114566	Zn	CombiCheck 40, 114692	2.00 mg/l	± 0.40 mg/l	–			119806
Zinc Test, 114832	Zn	–	1.25 mg/l*	± 0.20 mg/l	–			119806

* Self prepared, recommended concentration

Instructions for the Preparation of Standard Solutions

Standard solution of acid capacity

Reagents required:

1.09141.1000	Sodium hydroxide solution 0.1 mol/l Titripur®
1.16754.9010	Water for analysis EMSURE®

Preparation of a standard solution:
A sodium hydroxide solution of 0.1 mol/l (corresponds to 100 mmol/l) is used.

Further investigational concentrations may be prepared from this standard solution by diluting accordingly with distilled water.

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

Standard solution of bromine analogous to DIN EN ISO 7393

Reagents required:

1.02404.0100	Potassium iodate, volum. standard
1.05043.0250	Potassium iodide for analysis EMSURE®
1.09072.1000	Sulfuric acid 0.5 mol/l Titripur®
1.09136.1000	Sodium hydroxide solution 2 mol/l Titripur®
1.16754.9010	Water for analysis EMSURE®

Preparation of a KIO_3 stock solution:
Dissolve 1.006 g of KIO_3 in 250 ml of distilled water in a calibrated or conformity-checked 1000-ml volumetric flask. Subsequently make up to the mark with distilled water.

Preparation of a KIO_3/KI standard solution:
Transfer 11.13 ml of the KIO_3 stock solution to a calibrated or conformity-checked 1000-ml volumetric flask, add approx. 1 g of KI and make up to the mark with distilled water.
1 ml of this solution is equivalent to 0.025 mg of bromine.

Preparation of the bromine standard solution:
Pipette 20.0 ml (full pipette) KIO_3/KI standard solution into a calibrated or conformity-checked 100-ml volumetric flask, add 2.0 ml of H_2SO_4 0.5 mol/l, leave to stand for 1 min, and then add NaOH 2 mol/l dropwise (approx. 1 ml) until the solution just loses its color. Subsequently make up the solution to the mark with distilled water.
The concentration of the solution is 5.00 mg/l bromine.

Stability:
The KIO_3 stock solution remains stable for 4 weeks when stored in a cool place (refrigerator). The KIO_3/KI standard solution can be used for 5 hours when stored in a cool place (refrigerator). The diluted bromine standard solution is not stable and must be used immediately.

Instructions for the Preparation of Standard Solutions

Standard solution of calcium

Reagents required:

1.02121.0500	Calcium nitrate tetrahydrate for analysis EMSURE®
1.16754.9010	Water for analysis EMSURE®

Preparation of a standard solution:
Dissolve 2.946 g of calcium nitrate tetrahydrate with distilled water in a calibrated or conformity-checked 500-ml volumetric flask and make up to the mark with distilled water.
The standard solution prepared according to this procedure has a concentration of 1000 mg/l calcium.

Further investigational concentrations may be prepared from this standard solution by diluting accordingly with distilled water.

Stability:
The standard solution of 1000 mg/l remains stable for one week. The diluted standard solutions (investigational concentrations) remain stable for one day.

Standard solutions of free chlorine

All standard solutions described here for free chlorine yield equivalent results and are identically suited for the determination of chlorine.

Standard solution of free chlorine

Reagents required:

1.10888.0250	Dichloroisocyanuric acid sodium salt dihydrate GR for analysis
1.16754.9010	Water for analysis EMSURE®

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

Further investigational concentrations may be prepared from this standard solution by diluting accordingly with distilled water.

Stability:
When stored in a cool place (refrigerator), the standard solution of 1000 mg/l and the diluted standard solutions (investigational concentrations) remain stable for one day.

Note:
This is a standard solution that can be prepared particularly rapidly and easily.

Instructions for the Preparation of Standard Solutions

Standard solution of free chlorine analogous to DIN EN ISO 7393

Preparation of a KIO_3 stock solution:
Dissolve 1.006 g of KIO_3 in 250 ml of distilled water in a calibrated or conformity-checked 1000-ml volumetric flask. Subsequently make up to the mark with distilled water.

Preparation of a KIO_3/KI standard solution:
Transfer 15.00 ml (5.00 ml) of the KIO_3 stock solution to a calibrated or conformity-checked 1000-ml volumetric flask, add approx. 1 g of KI and make up to the mark with distilled water.
1 ml of this solution is equivalent to 0.015 mg (0.005 mg) of free chlorine.

Preparation of the chlorine standard solution:
Pipette 20.0 ml (10.0 ml) (full pipette) KIO_3/KI standard solution into a calibrated or conformity-checked 100-ml volumetric flask, add 2.0 ml of H_2SO_4 0.5 mol/l, leave to stand for 1 min, and then add NaOH 2 mol/l dropwise (approx. 1 ml) until the solution just loses its color. Subsequently make up the solution to the mark with distilled water.
The concentration of the solution is 3.00 mg/l (0.500 mg/l) free chlorine.

Stability:
The KIO_3 stock solution remains stable for 4 weeks when stored in a cool place (refrigerator). The KIO_3/KI standard solution can be used for 5 hours when stored in a cool place (refrigerator). The diluted chlorine standard solution is not stable and must be used immediately.

Note:
This procedure involves the preparation according to a standardized method.

Reagents required:

1.02404.0100	Potassium iodate, volum. standard
1.05043.0250	Potassium iodide for analysis EMSURE®
1.09072.1000	Sulfuric acid 0.5 mol/l Titripur®
1.09136.1000	Sodium hydroxide solution 2 mol/l Titripur®
1.16754.9010	Water for analysis EMSURE®

Instructions for the Preparation of Standard Solutions

Standard solution of free chlorine

Reagents required:

1.00316.1000	Hydrochloric acid 25 % for analysis EMSURE®
1.05614.9025	Sodium hypochlorite solution techn. approx. 13 % active chlorine
1.09147.1000	Sodium thiosulfate solution 0.1 mol/l Titripur®
1.05043.0250	Potassium iodide GR for analysis
1.05445.0500	Zinc iodide-starch solution GR for analysis
1.16754.9010	Water for analysis EMSURE®

Preparation of a stock solution:
First prepare a 1:10 dilution using a sodium hypochlorite solution containing approx. 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 distilled water.

Precise assay of the stock solution:
Pipette 10.0 ml of the stock solution into a 250-ml ground-glass-stoppered conical flask containing 60 ml of distilled water. Subsequently add to this solution 5 ml of hydrochloric acid 25% and 3 g of potassium iodide. Close the conical flask with the ground-glass stopper, mix thoroughly, and leave to stand for 1min.

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

Calculation and preparation of a standard solution:

Consumption of sodium thiosulfate solution 0.1 mol/l (ml) x 355 =
= content of free chlorine, in mg/l

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

Stability:
When stored in a cool place (refrigerator), a standard solution remains stable for approx. one week. The diluted standard solutions (investigational concentrations) are stable for approx. 2 hours.

Note:
This is a standard solution that is absolutely necessary for the preparation of the monochloramine standard.

Standard solution of total chlorine

Reagents required:

1.02426.0250	Chloramine T trihydrate GR for analysis
1.16754.9010	Water for analysis EMSURE®

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

Further investigational concentrations may be prepared from this standard solution by diluting accordingly with distilled water.

Stability:
When stored in a cool place (refrigerator), the standard solution of 1000 mg/l and the diluted standard solutions (investigational concentrations) remain stable for one day.

Instructions for the Preparation of Standard Solutions

Standard solution of chlorine dioxide analogous to DIN EN ISO 7393

Reagents required:

1.02404.0100	Potassium iodate, volum. standard
1.05043.0250	Potassium iodide for analysis EMSURE®
1.09072.1000	Sulfuric acid 0.5 mol/l Titripur®
1.09136.1000	Sodium hydroxide solution 2 mol/l Titripur®
1.16754.9010	Water for analysis EMSURE®

Preparation of a KIO_3 stock solution:
Dissolve 1.006 g of KIO_3 in 250 ml of distilled water in a calibrated or conformity-checked 1000-ml volumetric flask. Subsequently make up to the mark with distilled water.

Preparation of a KIO_3/KI standard solution:
Transfer 13.12 ml of the KIO_3 stock solution to a calibrated or conformity-checked 1000-ml volumetric flask, add approx. 1 g of KI and make up to the mark with distilled water.
1 ml of this solution is equivalent to 0.025 mg of chlorine dioxide.

Preparation of the chlorine dioxide standard solution:
Pipette 20.0 ml (full pipette) KIO_3/KI standard solution into a calibrated or conformity-checked 100-ml volumetric flask, add 2.0 ml of H_2SO_4 0.5 mol/l, leave to stand for 1 min, and then add NaOH 2 mol/l dropwise (approx. 1 ml) until the solution just loses its color. Subsequently make up the solution to the mark with distilled water.
The concentration of the solution is 5.00 mg/l chlorine dioxide.

Stability:
The KIO_3 stock solution remains stable for 4 weeks when stored in a cool place (refrigerator). The KIO_3/KI standard solution can be used for 5 hours when stored in a cool place (refrigerator). The diluted chlorine dioxide standard solution is not stable and must be used immediately.

Standard solution of COD

Reagents required:

1.02400.0080	Potassium hydrogen phthalate GR for analysis, volum. standard
1.16754.9010	Water for analysis EMSURE®

Preparation of a standard solution:
Dissolve 0.850 g of potassium hydrogen phthalate GR with distilled water in a calibrated or conformity-checked 1000-ml volumetric flask and make up to the mark with distilled water.
The standard 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 with distilled water.

Stability:
When stored in a cool place (refrigerator), the standard solution remains stable for one month. When stored under appropriate cool conditions (refrigerator), the diluted standard solutions (investigational concentrations) remain stable – depending on the respective concentration – for approx. one week to one month.

Instructions for the Preparation of Standard Solutions

Standard solution of COD/chloride

Reagents required:

1.02400.0080	Potassium hydrogen phthalate GR for analysis, volum. standard
1.06404.0500	Sodium chloride for analysis EMSURE®
1.16754.9010	Water for analysis EMSURE®

Preparation of a chloride dilution solution:
Dissolve 32.9 g of sodium chloride GR with distilled water in a calibrated or conformity-checked 1000-ml volumetric flask and make up to the mark with distilled water.
The dilution solution prepared according to this procedure has a concentration of 20 g/l Cl^-.

Preparation of a COD/Cl^- standard solution:
Dissolve 0.850 g of potassium hydrogen phthalate GR with **dilution solution** in a calibrated or conformity-checked 100-ml volumetric flask and make up to the mark with **dilution solution**.
The standard solution prepared according to this procedure has a concentration of 1000 mg/l and 20 g/l Cl^-.

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

Stability:
When stored in a cool place (refrigerator), the dilution solution of 20 g/l Cl^- and the standard solution of 10 000 mg/l COD / 20 g/l Cl^- remain stable for one month. When stored under appropriate cool conditions (refrigerator), the diluted standard solutions (investigational concentrations) remain stable - depending on the respective concentration - for approximately one week to one month.

Standard solution of cyanuric acid

Reagents required:

8.20358.0005	Cyanuric acid for synthesis
1.16754.9010	Water for analysis EMSURE®

Preparation of a standard solution:
Dissolve 1.00 g of cyanuric acid with distilled water in a calibrated or conformity-checked 1000-ml volumetric flask and make up to the mark with distilled water. The substance is slightly soluble and the dissolution process may take several hours.
The standard solution prepared according to this procedure has a concentration of 1000 mg/l cyanuric acid.

Further investigational concentrations may be prepared from this standard solution by diluting accordingly with distilled water.

Stability:
When stored in a cool place (refrigerator), the standard solution of 1000 mg/l and the diluted standard solutions (investigational concentrations) remain stable for one day.

Instructions for the Preparation of Standard Solutions

Standard solution of formaldehyde

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

Precise assay of the stock solution:
Pipette 40.0 ml (full pipette) of the formaldehyde stock solution 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 %. Subsequently titrate with sodium thiosulfate solution 0.1 mol/l until the yellow iodine color has disappeared, add 1 ml of zinc iodide-starch solution, and continue to titrate until a milky, pure white color emerge.

Calculation and preparation of a standard solution:

C1 = consumption of sodium thiosulfate solution 0.1 mol/l (ml)
C2 = quantity of iodine solution 0.05 mol/l (50,0 ml)

mg/l formaldehyde = (C2 – C1) x 37.525

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

Stability:
When stored in a cool place (refrigerator), the stock solution of approx. 1000 mg/l remains stable for one week. After this time, the stock solution must be determined anew. The diluted standard solutions (investigational concentrations) must be used immediately.

Reagents required:

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

Instructions for the Preparation of Standard Solutions

Standard solution of hydrazine

Reagents required:

1.04603.0100	Hydrazinium sulfate GR for analysis
1.16754.9010	Water for analysis EMSURE®

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

Further investigational concentrations may be prepared from this standard solution by diluting accordingly with oxygen-low distilled water.

Stability:
When stored in a cool place (refrigerator), the standard solution of 1000 mg/l and the diluted standard solutions (investigational concentrations) remain stable for one day.

Standard solution of hydrogen peroxide

Reagents required:

1.09122.1000	Potassium permanganate solution 0.02 mol/l Titripur®
1.07209.0250	Perhydrol® 30% for analysis EMSURE®
1.00716.1000	Sulfuric acid 25% for analysis EMSURE®
1.16754.9010	Water for analysis EMSURE®

Preparation of a stock solution:
Place 10.0 ml of Perhydrol® 30% H_2O_2 in a calibrated or conformity-checked 100-ml volumetric flask and make up to the mark with distilled water. Transfer 30.0 ml (full pipette) of this solution to a calibrated or conformity-checked 1000-ml volumetric flask and make up to the mark with distilled water.
The stock solution prepared according to this procedure has a concentration of approx. 1000 mg/l hydrogen peroxide.

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

Calculation and preparation of a standard solution:

Consumption of potassium permanganate solution 0.02 mol/l (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 with distilled water.

Stability:
When stored in a cool place (refrigerator), the stock solution of approx. 1000 mg/l and the diluted standard solutions (investigational concentrations) remain stable for one day.

Instructions for the Preparation of Standard Solutions

Standard solution of iodine analogous to DIN EN ISO 7393

Reagents required:

1.02404.0100	Potassium iodate, volum. standard
1.05043.0250	Potassium iodide for analysis EMSURE®
1.09072.1000	Sulfuric acid 0.5 mol/l Titripur®
1.09136.1000	Sodium hydroxide solution 2 mol/l Titripur®
1.16754.9010	Water for analysis EMSURE®

Preparation of a KIO_3 stock solution:
Dissolve 1.006 g of KIO_3 in 250 ml of distilled water in a calibrated or conformity-checked 1000-ml volumetric flask. Subsequently make up to the mark with distilled water.

Preparation of a KIO_3/KI standard solution:
Transfer 7.00 ml of the KIO_3 stock solution to a calibrated or conformity-checked 1000-ml volumetric flask, add approx. 1 g of KI and make up to the mark with distilled water.
1 ml of this solution is equivalent to 0.025 mg of iodine.

Preparation of the iodine standard solution:
Pipette 20.0 ml (full pipette) KIO_3/KI standard solution into a calibrated or conformity-checked 100-ml volumetric flask, add 2.0 ml of H_2SO_4 0.5 mol/l, leave to stand for 1 min, and then add NaOH 2 mol/l dropwise (approx. 1 ml) until the solution just loses its color. Subsequently make up the solution to the mark with distilled water.
The concentration of the solution is 5.00 mg/l iodine.

Stability:
The KIO_3 stock solution remains stable for 4 weeks when stored in a cool place (refrigerator). The KIO_3/KI standard solution can be used for 5 hours when stored in a cool place (refrigerator). The diluted iodine standard solution is not stable and must be used immediately.

Standard solution of magnesium

Reagents required:

1.05853.0500	Magnesium nitrate hexahydrate for analysis EMSURE®
1.16754.9010	Water for analysis EMSURE®

Preparation of a standard solution:
Dissolve 1.055 g of magnesium nitrate hexahydrate with distilled water in a calibrated or conformity-checked 100-ml volumetric flask and make up to the mark with distilled water.
The standard solution prepared according to this procedure has a concentration of 1000 mg/l magnesium.

Further investigational concentrations may be prepared from this standard solution by diluting accordingly with distilled water.

Stability:
The standard solution of 1000 mg/l remains stable for one week. The diluted standard solutions (investigational concentrations) remain stable for one day.

Instructions for the Preparation of Standard Solutions

Standard solution of monochloramine

Preparation of a standard solution:
Place 5.0 ml of chlorine standard solution 100 mg/l Cl_2 and 10.0 ml ammonium standard solution 10 mg/l NH_4-N in a calibrated or conformity-checked 100-ml volumetric flask and make up to the mark with distilled water.
The standard solution prepared according to this procedure has a concentration of 5.00 mg/l Cl_2 or 3.63 mg/l NH_2Cl.

Stability:
The standard solution is not stable and must be used immediately.

Reagents required:

	Chlorine standard solution 100 mg/l Cl_2 Preparation see "Standard solution of free chlorine" with hypochlorite solution (standard solution that is absolutely necessary for the preparation of the monochloramine standard)
	Ammonium standard solution 10 mg/l NH_4-N Preparation with Ammonium standard solution Certipur®, Cat.No. 1.19812.0500, 1000 mg/l NH_4 = = 777 mg/l NH_4-N
1.16754.9010	Water for analysis EMSURE®

Standard solution of nitrogen (total)

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

Further investigational concentrations may be prepared from this standard solution by diluting accordingly with distilled water.

Stability:
When stored in a cool place (refrigerator), the standard solution of 1000 mg/l remains stable for one week. The diluted standard solutions (investigational concentrations) must be used immediately.

Reagents required:

1.04201.0100	Glycine GR for analysis
1.16754.9010	Water for analysis EMSURE®

Standard solution of oxygen scavengers

Preparation of a standard solution:
Dissolve 1.00 g of N,N-diethylhydroxylamine with distilled water in a calibrated or conformity-checked 1000-ml volumetric flask and make up to the mark with distilled water.
The standard solution prepared according to this procedure has a concentration of 1000 mg/l N,N-diethylhydroxylamine (DEHA).

Further investigational concentrations may be prepared from this standard solution by diluting accordingly with distilled water.

Stability:
When stored in a cool place (refrigerator), the standard solution of 1000 mg/l and the diluted standard solutions (investigational concentrations) remain stable for one day.

Reagents required:

8.18473.0050	N,N-Diethylhydroxylamine for synthesis
1.16754.9010	Water for analysis EMSURE®

Instructions for the Preparation of Standard Solutions

Standard solution of ozone analogous to DIN EN ISO 7393

Reagents required:

1.02404.0100	Potassium iodate, volum. standard
1.05043.0250	Potassium iodide for analysis EMSURE®
1.09072.1000	Sulfuric acid 0.5 mol/l Titripur®
1.09136.1000	Sodium hydroxide solution 2 mol/l Titripur®
1.16754.9010	Water for analysis EMSURE®

Preparation of a KIO_3 stock solution:
Dissolve 1.006 g of KIO_3 in 250 ml of distilled water in a calibrated or conformity-checked 1000-ml volumetric flask. Subsequently make up to the mark with distilled water.

Preparation of a KIO_3/KI standard solution:
Transfer 14.80 ml of the KIO_3 stock solution to a calibrated or conformity-checked 1000-ml volumetric flask, add approx. 1 g of KI 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 20.0 ml (full pipette) KIO_3/KI standard solution into a calibrated or conformity-checked 100-ml volumetric flask, add 2.0 ml of H_2SO_4 0.5 mol/l, leave to stand for 1 min, and then add NaOH 2 mol/l dropwise (approx. 1 ml) until the solution just loses its color. 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 (refrigerator). The KIO_3/KI standard solution can be used for 5 hours when stored in a cool place (refrigerator). The diluted ozone standard solution is not stable and must be used immediately.

Standard solution of phenol

Reagents required:

1.00206.0250	Phenol GR for analysis
1.16754.9010	Water for analysis EMSURE®

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

Further investigational concentrations may be prepared from this standard solution by diluting accordingly with distilled water.

Stability:
When stored in a cool place (refrigerator), the standard solution of 1000 mg/l remains stable for one week. The diluted standard solutions (investigational concentrations) must be used immediately.

Instructions for the Preparation of Standard Solutions

Standard solution of silicate

Reagents required:

1.70236.0100	Silicone standard solution Certipur®
1.16754.9010	Water for analysis EMSURE®

Preparation of a standard solution:
A silicon standard solution of 1000 mg/l Si is used.
1000 mg/l Si corresponds to 2139 mg/l SiO_2.

Further investigational concentrations may be prepared by diluting accordingly with distilled water.

Example:
Mix 4.675 ml of silicon standard solution (1000 mg/l Si) with distilled water in a calibrated or conformity-checked 1000-ml volumetric flask and make up to the mark with distilled water.
The standard solution prepared according to this procedure has a concentration of 10.00 mg/l SiO_2.
After its preparation, the solution must be immediately transferred to a clean polyethylene vessel for further storage.
Further investigational concentrations may be prepared from this standard solution by diluting accordingly with distilled water.
After its preparation, the solution with the desired working concentration must be immediately transferred to a clean polyethylene vessel for further storage.

Stability:
The diluted standard solutions (investigational concentrations) remain stable - depending on the respective concentration - for one day to approximately six months.

Standard solution of sodium

Reagents required:

1.19897.0500	Chloride standard solution Certipur®
1.16754.9010	Water for analysis EMSURE®

Preparation of a standard solution:
A chloride standard solution of 1000 mg/l is used.
1000 mg/l chloride corresponds to 649 mg/l sodium.

Further investigational concentrations may be prepared by diluting accordingly with distilled water.

Stability:
When stored in a cool place (refrigerator), the diluted standard solutions (investigational concentrations) remain stable for one month.

Instructions for the Preparation of Standard Solutions

Standard solution of sulfide

Reagents required:

	Sodium sulfide hydrate approx. 60 % GR for analysis
1.09099.1000	Iodine solution 0.05 mol/l Titripur®
1.09147.1000	Sodium thiosulfate solution 0.1 mol/l Titripur®
1.00716.1000	Sulfuric acid 25 % for analysis EMSURE®
1.05445.0500	Zinc iodide-starch solution GR for analysis
1.16754.9010	Water for analysis EMSURE®

Preparation of a stock solution:
Dissolve 5.0 g of glass-clear, if necessary washed crystals of sodium sulfide hydrate GR with distilled water in a calibrated or conformity-checked 1000-ml volumetric flask and make up to the mark with distilled water.
The stock solution prepared according to this procedure has a concentration of approx. 1000 mg/l sulfide.

Precise assay of the stock solution:
Place 100 ml of distilled water and 5.0 ml (full pipette) of sulfuric acid 25 % in a 500-ml ground-glass-stoppered conical flask. To this solution add 25.0 ml (full pipette) of the sulfide stock solution and 25.0 ml (full pipette) of iodine solution 0.05 mol/l. Shake the contents of the flask thoroughly for about 1 minute, subsequently titrate with sodium thiosulfate solution 0.1 mol/l until the yellow iodine color has disappeared, add 1 ml of zinc iodide-starch solution, and continue to titrate until a milky, pure white color emerges.

Calculation and preparation of the standard solution:

C1 = consumption of sodium thiosulfate 0.1 mol/l (ml)
C2 = quantity of iodine solution 0.05 mol/l (25.0 ml)

$$mg/l\ sulfide = (C2 - C1) \times 64.13$$

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

Stability:
When stored in a cool place (refrigerator), the stock solution of approx. 1000 mg/l remains stable for at most one day. The diluted standard solutions (investigational concentrations) must be used immediately.

Instructions for the Preparation of Standard Solutions

Standard solution of sulfite

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

Precise assay of the stock solution:
Place 50.0 ml (full pipette) of the sulfite stock solution and 5.0 ml (full pipette) of hydrochloric acid 25 % in a 300-ml conical flask.
To this solution add 25.0 ml (full pipette) of iodine solution 0.05 mol/l and process immediately. After mixing the contents of the flask, subsequently titrate with sodium thiosulfate solution 0.1 mol/l until the yellow iodine color has disappeared, add 1 ml of zinc iodide-starch solution, and continue to titrate from blue to colorless.

Calculation and preparation of the standard solution:

C1 = consumption of sodium thiosulfate 0.1 mol/l (ml)
C2 = quantity of iodine solution 0.05 mol/l (25.0 ml)

$$mg/l\ sulfite = (C2 - C1) \times 80.06$$

Further investigational concentrations may be prepared from the stock solution exactly determined according to the procedure described above by diluting accordingly with distilled water and buffer solution pH 9.00. This is done in the following manner:
Withdraw the desired aliquot from the stock solution, place in a calibrated or conformity-approved 1000-ml volumetric flask, add 20 ml of buffer solution pH 9.00, make up to the mark with distilled water, and mix.

Stability:
When stored in a cool place (refrigerator), the stock solution of approx. 1000 mg/l remains stable for at most one day. The diluted standard solutions (investigational concentrations) must be used immediately.

Reagents required:

1.06657.0500	Sodium sulfite anhydrous for analysis EMSURE®
1.08418.0100	Titriplex® III GR for analysis
1.09099.1000	Iodine solution 0.05 mol/l Titripur®
1.09147.1000	Sodium thiosulfate solution 0.1 mol/l Titripur®
1.00316.1000	Hydrochloric acid 25 % GR for analysis EMSURE®
1.05445.0500	Zinc iodide-starch solution GR for analysis
1.09461.1000	Buffer solution pH 9.00 Certipur®
1.16754.9010	Water for analysis EMSURE®

Instructions for the Preparation of Standard Solutions

Standard solution of surfactants (anionic)

Reagents required:

1.12146.0005	Sodium 1-dodecanesulfonate
1.16754.9010	Water for analysis EMSURE®

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

Further investigational concentrations may be prepared from this standard solution by diluting accordingly with distilled water.

Stability:
When stored in a cool place (refrigerator), the standard solution of 1000 mg/l remains stable for one month. The diluted standard solutions (investigational concentrations) must be used immediately.

Standard solution of surfactants (cationic)

Reagents required:

1.02342.0100	N-cetyl-N,N,N-trimethylammonium bromide GR for analysis
1.16754.9010	Water for analysis EMSURE®

Preparation of a standard solution:
Dissolve 1.00 g of N-cetyl-N,N,N-trimethyl-ammonium bromide GR with distilled water in a calibrated or conformity-checked 1000-ml volumetric flask and make up to the mark with distilled water.
The standard solution prepared according to this procedure has a concentration of 1000 mg/l cat-ionic surfactants.

Further investigational concentrations may be prepared from this standard solution by diluting accordingly with distilled water.

Stability:
When stored in a cool place (refrigerator), the standard solution of 1000 mg/l remains stable for one month. The diluted standard solutions (investigational concentrations) must be used immediately.

Standard solution of surfactants (nonionic)

Reagents required:

1.12298.0101	Triton® X-100
1.16754.9010	Water for analysis EMSURE®

Preparation of a standard solution:
Dissolve 1.00 g of Triton® X-100 with distilled water in a calibrated or conformity-checked 1000-ml volumetric flask and make up to the mark with distilled water.
The standard solution prepared according to this procedure has a concentration of 1000 mg/l non-ionic surfactants.

Further investigational concentrations may be prepared from this standard solution by diluting accordingly with distilled water.

Stability:
When stored in a cool place (refrigerator), the standard solution of 1000 mg/l remains stable for one week. The diluted standard solutions (investigational concentrations) must be used immediately.

Instructions for the Preparation of Standard Solutions

Standard solution of tin

Reagents required:

1.70242.0100	Tin standard solution Certipur®
1.09057.1000	Hydrochloric acid 1 mol/l Titripur®
1.16754.9010	Water for analysis EMSURE®

Preparation of a standard solution:
A tin standard solution of 1000 mg/l is used.
Transfer 30 ml of HCl 1 mol/l to a calibrated or conformity-checked 100-ml volumetric flask, add 10.0 ml (full pipette) of the tin standard solution, and make up to the mark with distilled water.
The standard solution prepared according to this procedure has a concentration of 100 mg/l tin.

Further investigational concentrations may be prepared from the standard solution by diluting accordingly with distilled water and HCl 1 mol/l. This is done in the following manner:
Transfer 1 ml of HCl 1 mol/l to a calibrated or conformity-checked 100-ml volumetric flask. Withdraw the desired aliquot from the tin standard solution 100 mg/l, add, make up to the mark with distilled water, and mix.

Stability:
The tin standard solution 100 mg/l remains stable for 30 minutes. The diluted standard solutions (investigational concentrations) must be used immediately.

Standard solution of total hardness

Reagents required:

1.02121.0500	Calcium nitrate tetrahydrate for analysis EMSURE®
1.16754.9010	Water GR for analysis

Preparation of a standard solution:
Dissolve 2.946 g of calcium nitrate tetrahydrate with distilled water in a calibrated or conformity-checked 500-ml volumetric flask and make up to the mark with distilled water.
The standard solution prepared according to this procedure has a concentration of 1000 mg/l calcium (corresponds to 175 °e).

Further investigational concentrations may be prepared from this standard solution by diluting accordingly with distilled water.

Stability:
The standard solution of 1000 mg/l remains stable for one week. The diluted standard solutions (investigational concentrations) remain stable for one day.

Standard solution of volatile organic acids

Reagents required:

1.06268.0250	Sodium acetate anhydrous for analysis EMSURE®
1.16754.9010	Water GR for analysis

Preparation of a standard solution:
Dissolve 2,05 g of sodium acetate anhydrous with distilled water in a calibrated or conformity-checked 1000-ml volumetric flask and make up to the mark with distilled water.
The standard solution prepared according to this procedure has a concentration of 1500 mg/l acetic acid.

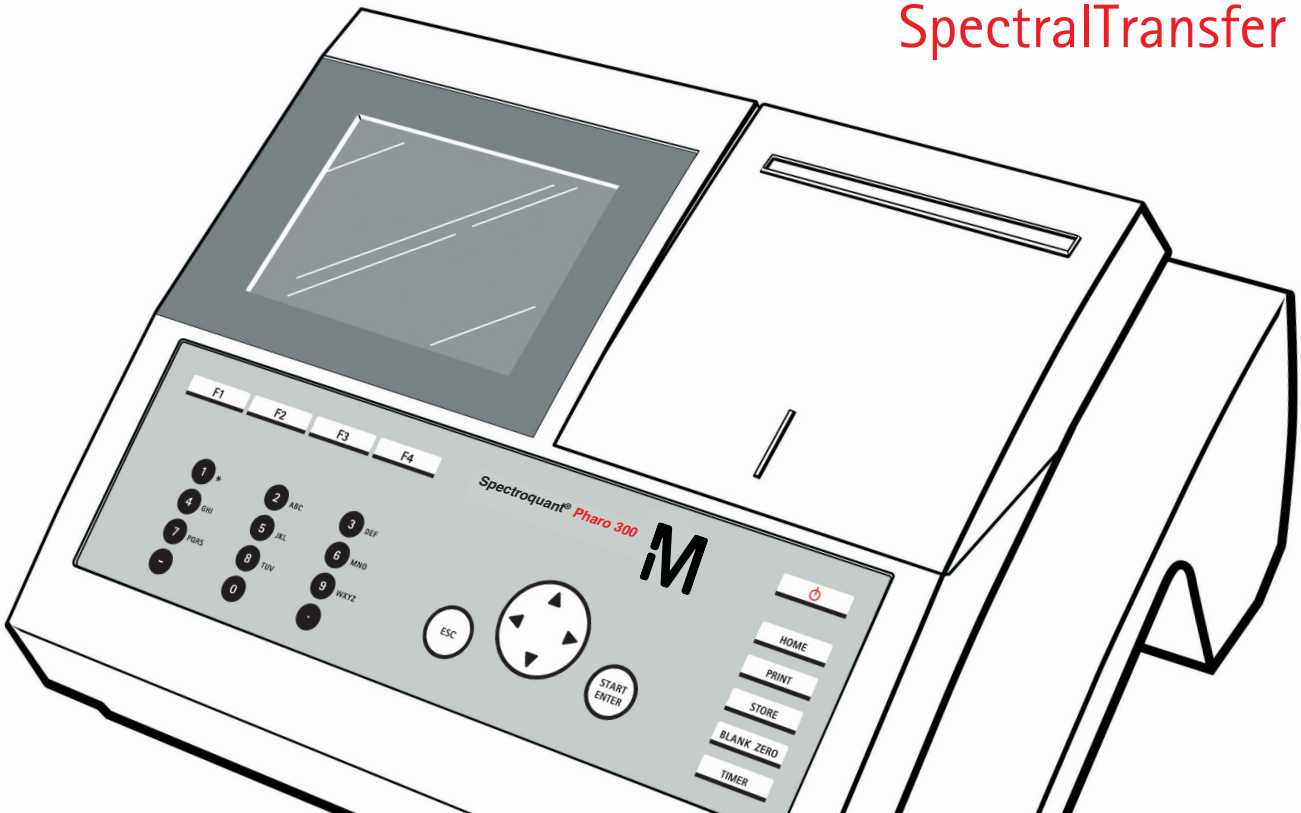
Stability:
When stored in a cool place (refrigerator), the standard solution remains stable for one week.

eng

Spectroquant® UV/VIS Spectrophotometer

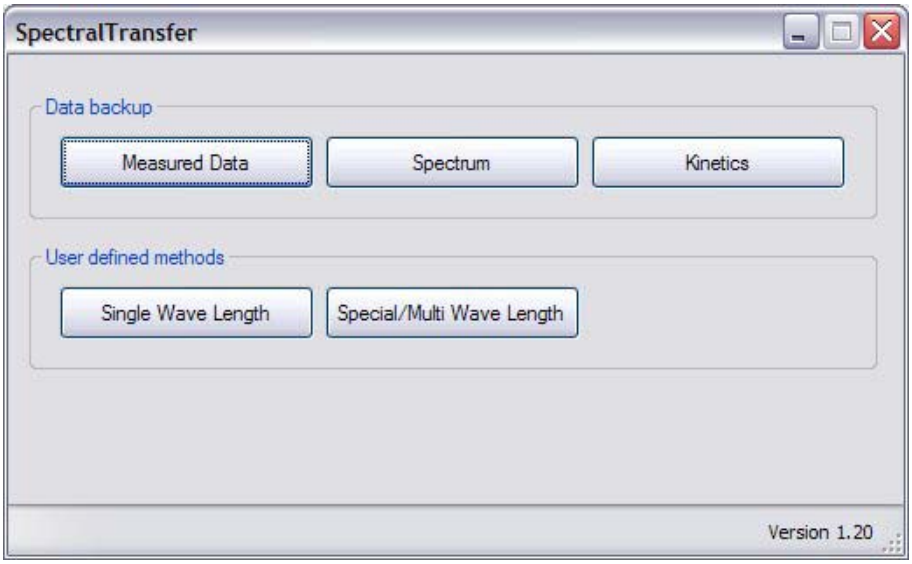
Pharo 300

Operating manual
SpectralTransfer



Operating manual

SpectralTransfer



- **Backup of measurement data**
- **Backup and recovery of user-defined methods**

01/2012

SpectralTransfer - Contents

.

1 Overview

The SpectralTransfer program is used for the direct data exchange between the photometer and PC. The SpectralTransfer program requires additional software on the PC for the data exchange (see section 2.1).

When all programs have been installed, you can:

- Save measurement data saved in the photometer in *.csv format to a PC
  - Exported measurement datasets from the measurement data memory (concentration, absorbance, transmission and multi-wavelengths measurements)
  - Spectra
  - Kinetic records
- Save and transmit user-defined methods
  - to a PC from the photometer
  - to the photometer from the PC (existing backup data)

Note
All functions can also be executed with a USB memory device connected to the photometer.

2 Installation

2.1 PC system requirements

- Windows® compatible PC with Pentium® or compatible processor (processor capacity depending on operating system)
- Free USB connection
- Operating system from Windows® XP.
- Synchronization software:
  - Microsoft® ActiveSync®, from version 4.5.0 for Windows® XP
  - Microsoft® Mobile Device Center for Windows® Vista and Windows® 7.

The programs and instructions for installation are available under www.microsoft.com.

2.2 Installation under Windows®

1	Insert the installation CD for the SpectralTransfer program in the CD drive.
2	Call up the Windows® Explorer.
3	In the Windows® Explorer, select the CD-ROM drive.
4	Double-click on the "SpectralTransfer\SpektralTransfer_Vxxx_Setup.exe" program.
5	Follow the instructions of the setup program. The program is installed.

Note
For the data exchange of the photometer and PC, the software "Microsoft® .NET Framework 2.0" or higher is required in addition to the SpectralTransfer program. If the "Microsoft ® .NET Framework 2.0" software is not yet available on the PC it is automatically installed as well.

3 Establishing the connection and starting the program

3.1 Connecting the photometer to the PC

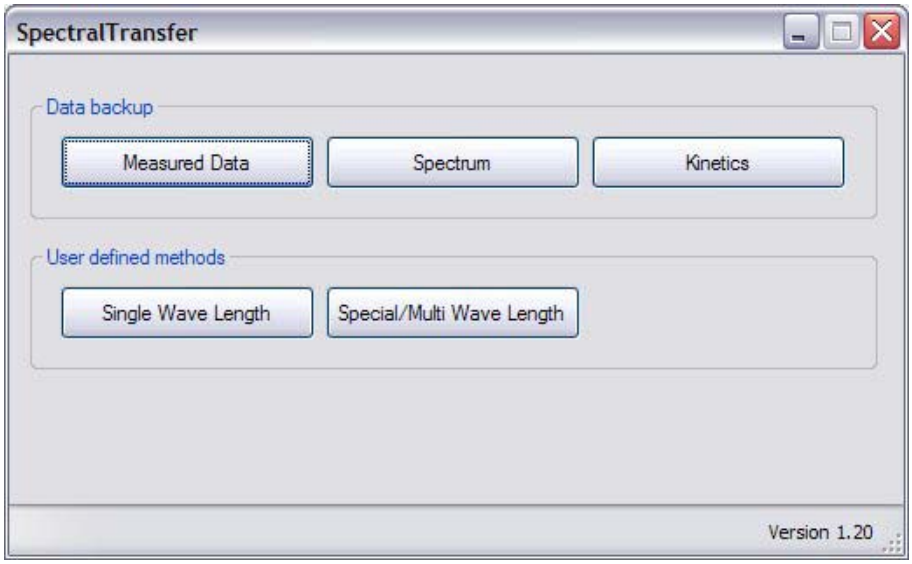
A USB cable (type A - type B) is required for the connection.
Proceed as follows:

1	Switch on the photometer.
2	Switch on the PC and log in if necessary.
3	Connect the photometer to the PC with the aid of the USB cable. The synchronization software identifies the connected device and starts automatically.
4	Windows® XP/ActiveSync® only: In the *New partnership* window, select the option *No* and press the *Continue* button.
5	The photometer is connected to the PC. You can now minimize or exit the synchronization software. The connection remains active in the background.

Note
The synchronization software is preset to start automatically as soon as the photometer is connected to the PC. If this setting has been changed you have to start the synchronization software manually, e.g. in the Windows® start menu. You can then adjust the connection settings (for details, see help function of the synchronization software).

3.2 Starting SpectralTransfer

In the Windows® start menu, click *Programs->SpectralTransfer->Spectral-Transfer*. The program starts. The SpectralTransfer main window appears.



4 Operation

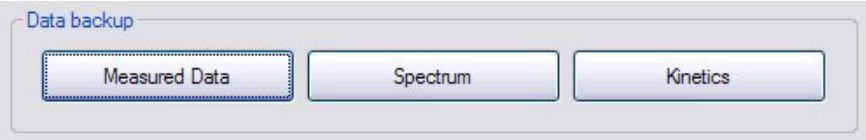
4.1 Backing up measurement data

Measurement data that should be saved to a PC must be available as *.csv files in the photometer. The following measurement data can be saved:

- Exported measurement datasets from the measurement data memory (concentration, absorbance, transmission and multi-wavelengths measurements)
- Spectra
- Kinetic records

Note
Spectra and kinetic records are automatically saved as *.csv files when stored. Measurement datasets in the measurement data memory are stored in an internal data format. These measurement datasets can be (filtered and) exported as a *.csv file to the photometer.

The backup of measurement data, spectra or kinetic records is started in the group box, *Data backup*:



Functions

Button	Function
Measured Data	Opens the dialog box to save the measurement datasets from the measuring modes, concentration, absorbance / % transmission and multi-wavelengths. Only those measurement datasets can be saved that were first exported as a *.csv file to the photometer. The backup on the PC is saved to a directory of your choice.
Spectrum	Opens the dialog box for the backup of all spectra (as a *.csv file) to a directory of your choice on the PC.
Kinetics	Opens the dialog box for the backup of all kinetic records (as a *.csv file) to a directory of your choice on the PC.

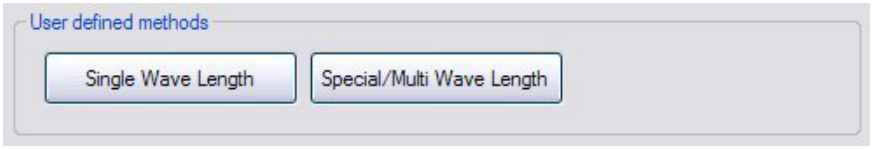
Example: Dialog box for the backup of measurement datasets (*Data Backup - Measured Data*)

Functions

Button	Function
Change Directory	Opens the directory selection dialog box. Here you determine the target directory on your PC.
Copy All -->	Copies all files from the source directory to the target directory. Already existing files with the same name are overwritten.
Clear	Deletes all files in the meter.

4.2 Backing up user-defined methods

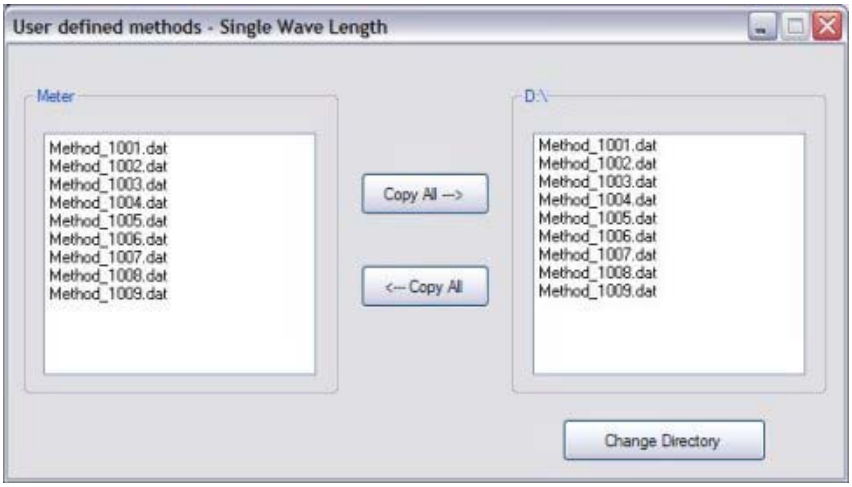
Here you canbackup and recover all user-defined methods for the measuring mode, *concentration*. Thus you can, e.g., transmit the user-defined methods to a different photometer.
The backing up of user-defined methods is started in the group field, *User defined methods*:



Functions

Button	Function
Single Wave Length	Opens the dialog box for the backup of all user-defined methods for the *concentration* measuring mode to a directory of your choice on the PC.

Dialog box, user defined methods

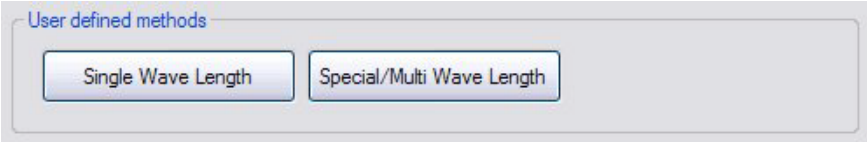


Functions

Button	Function
Change Directory	Opens a directory selection box. Here you determine the target directory on your PC.
Copy All --> <-- Copy All	Copies all files from the selected source directory to the target directory. Already existing files with the same name are overwritten.

4.3 Backing up the special/multi wave lengths methods

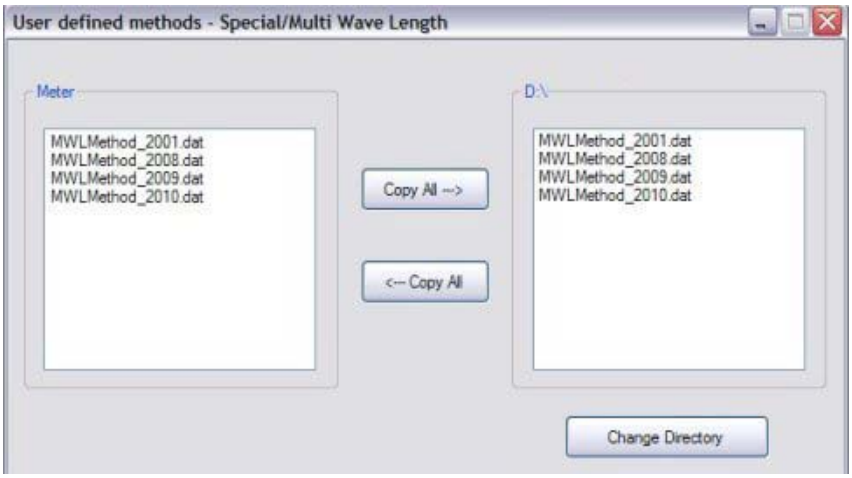
Here you can back up and recover all special/multi wavelengths methods. Thus you can, e.g., transmit the multi wavelengths methods to a different photometer.
The backing up of special/multi wave lengths methods is started in the group field, *User defined methods*:



Functions

Button	Function
Special/Multi Wave Lengths	Opens the dialog box for the backup of all special/multi wavelengths methods to a directory of your choice on the PC.

Dialog box, multi-wavelength methods



Functions

Button	Function
Change Directory	Opens a directory selection box. Here you determine the target directory on your PC.
Copy All --> <-- Copy All	Copies all files from the selected source directory to the target directory. Already existing files with the same name are overwritten.

5 What to do if ...

Error	Cause	Remedy
ERROR MESSAGE: *Connection failed!*	– No suitable photometer identified (the synchronization software did not start automatically)	– Connect the photometer – Interrupt and then restore the USB connection between the photometer and the PC – Disconnect the USB connection between the photometer and PC – Disconnect the photometer from the power supply – Connect the photometer to the power supply. – Establish the USB connection between the photometer and PC – Operating system Windows XP®: Make sure that the Microsoft® ActiveSync® synchronization software is installed
The Microsoft® ActiveSync® synchronization software does not start as a minimized window	– The settings in the ActiveSync® window *New partnership* do not correspond to the standard settings	– In the *New partnership* window, select the option *No* and press the *Continue >* button. The photometer is connected to the PC. – You can now minimize ActiveSync®. The connection remains active in the background. – Start the SpectralTransfer software (see section 3.2).

Merck KGaA, 64271 Darmstadt, Germany, Tel. +49(0)6151 72-2440
www.analytical-test-kits.com

EMD Millipore Corporation, 290 Concord Road, Billerica,
MA 01821, USA, Tel. +1-978-715-4321