Lovibond

PoolDirect

Instruction Manual GB

Safety precautions

⚠ CAUTION ⚠

Reagents are formulated exclusively for chemical analysis and must not be used for any other purpose. Reagents must not get into the hands of children. Some of the reagents contain substances which are not entirely harmless environmentally. Be aware of the ingredients and take proper care when disposing of the test solution.

⚠ CAUTION ⚠

Please read this instruction manual before unpacking, setting up or using the photometer. Please read the method description completely before performing the test. Be aware of the risks of using the required reagents by reading the MSDS (Material Safety Data Sheets). Failure could result in serious injury to the operator or damage to the instrument.

MSDS: www.tintometer.de

⚠ CAUTION ⚠

Use the charger unit only with rechargeable batteries. Failure can result in serious injury to the operator or damage to the instrument.
Do not use charger with non rechargeables batteries.

⚠ CAUTION ⚠

The accuracy of the instrument is only valid if the instrument is used in an environment with controlled electromagnetic disturbances according to DIN 61326. Wireless devices, e.g. wireless phones, must not be used near the instrument.

Revision_11a 03/2010

Table of contents

Part 1

Methods

1.1 Table of Methods

No.	Analysis	Reagent	Range as	Displayed	Method	λ [nm]	Page
20	**Acid demand to pH 4.3 T**	tablet	0.1-4	mmol/l	Acid/ Indicator [1,2,5]	610	10
30	**Alkalinity, total T**	tablet	5-200	mg/l $CaCO_3$	Acid / Indicator [1,2,5]	610	12
40	**Aluminium T**	tablet	0.01-0.3	mg/l Al	Eriochrome Cyanine R [2]	530	14
50	**Aluminium PP**	PP + liquid	0.01-0.25	mg/l Al	Eriochrome Cyanine R [2]	530	16
60	**Ammonia T**	tablet	0.02-1	mg/l N	Salicylate [2]	610	18
80	**Bromine T**	tablet	0.05-13	mg/l Br_2	DPD [5]	530	20
100	**Chlorine T ***	tablet	0.01-6	mg/l Cl_2	DPD [1,2,3]	530	22, 24
101	**Chlorine L ***	liquid	0.02-4	mg/l Cl_2	DPD [1,2,3]	530	22, 28
110	**Chlorine PP ***	PP	0.02-2	mg/l Cl_2	DPD [1,2]	530	22, 32
120	**Chlorine dioxide T**	tablet	0.05-11	mg/l ClO_2	DPD, Glycine [2]	530	36
150	**Copper T ***	tablet	0.05-5	mg/l Cu	Biquinoline [4]	560	42
153	**Copper PP**	PP	0.05-5	mg/l Cu	Bicinchoninate	560	46
160	**Cyanuric acid T**	tablet	2-160	mg/l Cys	Melamine	530	48
190	**Hardness, Calcium T**	tablet	50-900	mg/l $CaCO_3$	Murexide [4]	560	50
191	**Hardness, Calcium 2T**	tablet	0-500	mg/l $CaCO_3$	Murexide [4]	560	52
200	**Hardness, total T**	tablet	2-50	mg/l $CaCO_3$	Metallphthalein [3]	560	54
201	**Hardness, total HR T**	tablet	20-500	mg/l $CaCO_3$	Metallphthalein [3]	560	56
210	**Hydrogen peroxide**	tablet	0.03-3	mg/l H_2O_2	DPD/catalyst [5]	530	58
215	**Iodine T**	tablet	0.05-3.6	mg/l I	DPD [5]	530	60
220	**Iron T**	tablet	0.02-1	mg/l Fe	PPST [3]	560	62
290	**Oxygen, active T**	tablet	0.1-10	mg/l O_2	DPD	530	64
300	**Ozone (DPD) T**	tablet	0.02-2	mg/l O_3	DPD/Glycine [5]	530	66
70	**PHMB T**	tablet	2-60	mg/l PHMB	Buffer/ Indicator	560	72
319	**Phosphate, ortho LR T**	tablet	0.05-4	mg/l PO_4	Ammonium-molybdate [2,3]	610	74
330	**pH-Value T**	tablet	6.5-8.4	—-	Phenolred [5]	560	76
331	**pH-Value L**	liquid	6.5-8.4	—-	Phenolred [5]	560	78
212	**Sodium hypochlorite T**	tablet	0.2-16	% NaOCl	Potassium iodide [5]	530	80
355	**Sulfate T**	tablet	5-100	mg/l SO_4	Bariumsulfate-Turbidity	610	82
360	**Sulfate PP**	PP	5-100	mg/l SO_4	Bariumsulfate-Turbidity [2]	530	84

1.1 Methods

No.	Analysis	Reagent	Range as	Displayed	Method	λ [nm]	Page
390	**Urea T**	tablet + liquid	0.1-2.5	mg/l Urea	Indophenol/ Urease	610	86

* = free, combined, total; PP = Powder Pack; T = tablet;
L = liquid; LR = low range; MR = middle range; HR = high range

The precision of Lovibond® Reagent Systems (tablets, powder packs and tube tests) is identical to the precision specified in standards literature such as American Standards (AWWA), ISO etc.

Most of the data referred to in these standard methods relates to Standard Solutions. Therefore they are not readily applicable to drinking-, boiler- or waste-water, since various interferences can have a major influence on the accuracy of the method.

Due to the fact that each sample is different, the only way to check the tolerances ('precision') is the Standard Additions Method.

According to this method, first the original sample is tested. Then further samples (2 to 4) are taken and small amounts of a Standard Solution are added, and further results are obtained. The amounts added range from approximately half, up to double the amount present in the sample itself.
These supplementary results make it possible to estimate the actual concentration of the original sample by comparison.

Literature

The reagent formulations are based on internationally recognised test methods. Some are described in national and/or international guidelines.

1. Deutsche Einheitsverfahren zur Wasser-, Abwasser- und Schlammuntersuchung
2. Standard Methods for the Examination of Water and Wastewater; 18th Edition, 1992
3. Photometrische Analysenverfahren, Schwedt, Wissenschaftliche Verlagsgesellschaft mbH, Stuttgart 1989
4. Photometrische Analyse, Lange / Vejdelek, Verlag Chemie 1980
5. Colorimetric Chemical Analytical Methods, 9th Edition, London

Notes for searching:

Active Oxygen	->	Oxygen, activ
Alkalinity-m	->	Alkalinity, total
Alkalinity, total	->	Alkalinity, total
Biguanide	->	PHMB
Calcium Hardness	->	Hardness, Calcium
Total Hardness	->	Hardness, total
m-Value	->	Alkalinity, total
p-Value	->	Alkalinity-p
Langelier Saturation Index (Water Balance)	**->**	**Mode function 70**

1.1 Methods

2 0 Acid demand to pH 4.3 with Tablet

0.1 – 4 mmol/l

Ø 24 mm

1. Fill a clean vial (24 mm Ø) with **10 ml of the water sample**, close tightly with the cap.

2. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

prepare Zero
press ZERO

3. Press **ZERO** key.

4. Remove the vial from the sample chamber.

5. Add **one ALKA-M-PHOTOMETER tablet** straight from the foil to the water sample and crush the tablet using a clean stirring rod.

6. Close the vial tightly with the cap and swirl gently several times until the tablet is dissolved.

7. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

Zero accepted
prepare Test
press TEST

8. Press **TEST** key.

The result is shown in the display as Acid demand to pH 4.3 in mmol/l.

1.1 Methods

Notes:

1. The terms total Alkalinity, Alkalinity-m, m-Value and Acid demand to pH 4.3 are identical.
2. For accurate results exactly 10 ml of the water sample must be taken for the test.

Precision

An educated operator obtained under laboratory conditions exemplary for 2 different (one) standard solutions the following standard deviations using different lots of reagent: 0.30 ± 0.04 mmol/l

1.1 Methods

3 0 Alkalinity, total = Alkalinity-m = m-Value with Tablet

5 – 200 mg/l $CaCO_3$


Ø 24 mm

1. Fill a clean vial (24 mm Ø) with **10 ml of the water sample**, close tightly with the cap.

2. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

prepare Zero
press ZERO

3. Press **ZERO** key.

4. Remove the vial from the sample chamber.

5. Add **one ALKA-M-PHOTOMETER tablet** straight from the foil to the water sample and crush the tablet using a clean stirring rod.

6. Close the vial tightly with the cap and swirl gently several times until the tablet is dissolved.

7. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

Zero accepted
prepare Test
press TEST

8. Press **TEST** key.

The result is shown in the display as total alkalinity.

1.1 Methods

Notes:

1. The terms total Alkalinity, Alkalinity-m, m-Value and Alkalinity to pH 4.3 are identical.
2. For accurate results exactly 10 ml of water sample must be taken for the test.
3. Conversion table:

	Acid demand to pH 4.3 DIN 38 409 ($KS_{4.3}$)	German °dH*	English °eH*	French °fH*
1 mg/l $CaCO_3$	0.02	0.056	0.07	0.1

*Carbonate hardness (reference = Hydrogencarbonate-anions)

Example:
10 mg/l $CaCO_3$ = 10 mg/l x 0.056 = 0.56 °dH
10 mg/l $CaCO_3$ = 10 mg/l x 0.02 = 0.2 mmol/l

4. ▲ $CaCO_3$
   °dH
   °eH
   °fH
   ▼ °aH

Precision

An educated operator obtained under laboratory conditions exemplary for 2 different (one) standard solutions the following standard deviations using different lots of reagent: 140.00 ± 4.00 mg/l

1.1 Methods

4 0 Aluminium with Tablet

0.01 – 0.3 mg/l Al

Ø 24 mm

1. Fill a clean vial (24 mm Ø) with **10 ml of the water sample**, close tightly with the cap.

2. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

prepare Zero
press ZERO

3. Press **ZERO** key.

4. Remove the vial from the sample chamber.

5. Add **one ALUMINIUM No. 1 tablet** straight from the foil to the water sample and crush the tablet using a clean stirring rod (dissolve the tablet).

6. Add **one ALUMINIUM No. 2 tablet** straight from the foil to the same water sample and crush the tablet using a clean stirring rod.

7. Close the vial tightly with the cap and swirl gently several times until the tablets are dissolved.

8. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

Zero accepted
prepare Test
press TEST

9. Press **TEST** key.

   Wait for a **reaction period of 5 minutes.**

Countdown
5:00

After the reaction period is finished the measurement starts automatically.

The result is shown in the display in mg/l Aluminium.

1.1 Methods

Notes:

1. Before use, clean the vials and the measuring beaker with Hydrochloric acid (approx. 20%). Rinse them thoroughly with deionised water.
2. To get accurate results the sample temperature must be between 20°C and 25°C.
3. A low test result may be given in the presence of Fluorides and Polyphosphates. The effect of this is generally insignificant unless the water has fluoride added artificially. In this case, the following table should be used:

Fluoride	Displayed value: Aluminium [mg/l Al]					
[mg/l F]	0.05	0.10	0.15	0.20	0.25	0.30
0.2	0.05	0.11	0.16	0.21	0.27	0.32
0.4	0.06	0.11	0.17	0.23	0.28	0.34
0.6	0.06	0.11	0.17	0.23	0.28	0.34
0.8	0.06	0.13	0.20	0.26	0.32	0.40
1.0	0.07	0.13	0.21	0.28	0.36	0.45
1.5	0.09	0.20	0.29	0.37	0.48	---

   Example: If the result of Aluminium determination is 0.15 mg/l Al and the Fluoride concentration is known to be 0.4 mg/l F, the true concentration of Aluminium is 0.17 mg/l Al.

4. ▲ Al
   ▼ Al_2O_3

Precision

An educated operator obtained under laboratory conditions exemplary for 2 different (one) standard solutions the following standard deviations using different lots of reagent: 0.03 ± 0.01 mg/l; 0.20 ± 0.02 mg/l

1.1 Methods

5 0 Aluminium with Vario Powder Pack

0.01 – 0.25 mg/l Al

Ø 24 mm

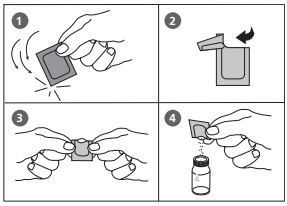
Use two clean vials (24 mm ø) and mark one as blank for zeroing.

1. Fill **20 ml of water sample** in a 100 ml beaker.
2. Add the contents of **one Vario Aluminum ECR F20 Powder Pack** straight from the foil into the water sample.
3. Dissolve the powder using a clean stirring rod.

Countdown 1
0:30
start: ↵

4. Press [↵] key.
   Wait for a **reaction period of 30 seconds.**

After the reaction period is finished proceed as follows:



5. Add the contents of **one Vario Hexamine F20 Powder Pack** straight from the foil into the same water sample.
6. Dissolve the powder using a clean stirring rod.
7. Add **1 drop of Vario Aluminum ECR Masking Reagent** in the vial marked as blank.
8. Add 10 ml of the prepared water sample to the vial **(this is the blank)**.
9. Add the remaining 10 ml of the prepared water sample in the second clean vial **(this is the sample)**.
10. Close the vials tightly with the caps and swirl several times to mix the contents.

Countdown 2
5:00
start: ↵

11. Press [↵] key.
    Wait for **a reaction period of 5 minutes**.

1.1 Methods

After the reaction period is finished proceed as follows:

12. Place the vial **(the blank)** in the sample chamber making sure that the ⧖ marks are aligned.

prepare Zero
press ZERO

13. Press **ZERO** key.

14. Remove the vial from the sample chamber.

15. Place the vial **(the sample)** in the sample chamber making sure that the ⧖ marks are aligned.

Zero accepted
prepare Test
press TEST

16. Press **TEST** key.

The result is shown in the display in mg/l Aluminium.

Notes:

1. Before use, clean the vials and the measuring beaker with Hydrochloric acid (approx. 20%). Rinse them thoroughly with deionised water.
2. To get accurate results the sample temperature must be between 20°C and 25°C.

A low test result may be given in the presence of Fluorides and Polyphosphates. The effect of this is generally insignificant unless the water has fluoride added artificially. In this case, the following table should be used:

Fluoride	Displayed value: Aluminium [mg/l Al]					
[mg/l F]	0.05	0.10	0.15	0.20	0.25	0.30
0.2	0.05	0.11	0.16	0.21	0.27	0.32
0.4	0.06	0.11	0.17	0.23	0.28	0.34
0.6	0.06	0.11	0.17	0.23	0.28	0.34
0.8	0.06	0.13	0.20	0.26	0.32	0.40
1.0	0.07	0.13	0.21	0.28	0.36	0.45
1.5	0.09	0.20	0.29	0.37	0.48	---

Example: If the result of Aluminium determination is 0.15 mg/l Al and the Fluoride concentration is known to be 0.4 mg/l F, the true concentration of Aluminium is 0.17 mg/l Al.

3. ▲ Al
   ▼ Al_2O_3

Precision

An educated operator obtained under laboratory conditions exemplary for 2 different (one) standard solutions the following standard deviations using different lots of reagent: 0.03 ± 0.01 mg/l; 0.20 ± 0.02 mg/l

1.1 Methods

6 0 Ammonia with Tablet

0.02 – 1 mg/l N

Ø 24 mm

1. Fill a clean vial (24 mm Ø) with **10 ml of the water sample**, close tightly with the cap.
2. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

prepare Zero
press ZERO

3. Press **ZERO** key.
4. Remove the vial from the sample chamber.
5. Add **one AMMONIA No. 1 tablet** straight from the foil to the water sample and crush the tablet using a clean stirring rod.
6. Add **one AMMONIA No. 2 tablet** straight from the foil to the same water sample and crush the tablet using a clean stirring rod.
7. Close the vial tightly with the cap and swirl several times until the tablets are dissolved.
8. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

Zero accepted
prepare Test
press TEST

9. Press **TEST** key.

   Wait for a **reaction period of 10 minutes.**

Countdown
10:00

After the reaction period is finished the measurement starts automatically.

The result is shown in the display in mg/l Ammonia as N.

1.1 Methods

Notes:

1. The tablets must be added in the correct sequence.
2. The AMMONIA No. 1 tablet will only dissolve completely after the AMMONIA No. 2 tablet has been added.
3. The temperature of the sample is important for full colour development. At a temperature below 20°C the reaction period is 15 minutes.
4. Sea water samples
   Ammonia conditioning reagent is required when testing sea water or brackish water samples to prevent precipitation of salts.
   Fill the test tube with the sample to the 10 ml mark and add one level spoon of Conditioning Powder. Mix to dissolve, then continue as described in the test instructions.
5. Conversion:
   mg/l NH_4 = mg/l N x 1.29
   mg/l NH_3 = mg/l N x 1.22
6. ▲ N
   NH_4
   ▼ NH_3

Precision

An educated operator obtained under laboratory conditions exemplary for 2 different (one) standard solutions the following standard deviations using different lots of reagent:
0.05 ± 0.01 mg/l; 0,90 ± 0.03 mg/l

1.1 Methods

8 0 Bromine with Tablet

0.05 – 13 mg/l Br_2


Ø 24 mm

1. Fill a clean vial (24 mm Ø) with **10 ml of the water sample**, close tightly with the cap.
2. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

prepare Zero
press ZERO

3. Press **ZERO** key.
4. Remove the vial from the sample chamber and **empty it, leaving a few drops remaining in the vial.**
5. Add **one DPD No. 1 tablet** straight from the foil and crush the tablet using a clean stirring rod.
6. Add the water sample to the 10 ml mark.
7. Close the vial tightly with the cap and swirl several times until the tablet is dissolved.
8. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

Zero accepted
prepare Test
press TEST

9. Press **TEST** key.

The result is shown in the display in mg/l Bromine.

1.1 Methods

Notes:

1. Vial cleaning:
   As many household cleaners (e.g. dishwasher detergent) contain reducing substances, the subsequent determination of Bromine may show lower results. To avoid any measurement errors, only use glassware free of Chlorine demand.
   Preparation: Put all applicable glassware into Sodium hypochlorite solution (0.1 g/l) for one hour, then rinse all glassware thoroughly with deionised water.
2. Preparing the sample:
   When preparing the sample, the lost of Bromine, e.g. by pipetting or shaking, must be avoided. The analysis must take place immediately after taking the sample.
3. The DPD colour development is carried out at a pH value of 6.2 to 6.5. The reagent tablet therefore contains a buffer for the pH adjustment. Strong alkaline or acidic water samples must be adjusted between pH 6 and pH 7 before the reagent is added (use 0.5 mol/l Sulfuric acid resp. 1 mol/l Sodium hydroxide).
4. Exceeding the measuring range:
   Concentrations above 22 mg/l Bromine can lead to results showing 0 mg/l. In this case, the water sample must be diluted with water free of Bromine. 10 ml of the diluted sample should be mixed with the reagent and the measurement repeated.

   Oxidising agents such as Chlorine, Ozone etc. interfere as they react in the same way as Bromine.

Precision

An educated operator obtained under laboratory conditions exemplary for 2 different (one) standard solutions the following standard deviations using different lots of reagent: 0.40 ± 0.04 mg/l; 5.00 ± 0.15 mg/l

1.1 Methods

1 0 0 Chlorine with Tablet

0.01 – 6 mg/l Cl_2

1 0 1 Chlorine with Liquid Reagent

0.02 – 4 mg/l Cl_2

1 1 0 Chlorine with Vario Powder Pack

0.02 – 2 mg/l Cl_2

Chlorine T **>> diff** **free** **total**	The following selection is shown in the display:
>> diff	for the differentiated determination of free, combined and total Chlorine.
>> free	for the determination of free Chlorine.
>> total	for the determination of total Chlorine.

Select the desired determination with the arrow keys [▲] and [▼]. Confirm with [↵] key.

1.1 Methods

Notes:

1. Vial cleaning:
   As many household cleaners (e.g. dishwasher detergent) contain reducing substances, the subsequent determination of Chlorine may show lower results. To avoid any measurement errors, only use glassware free of Chlorine demand.
   Preparation: Put all applicable glassware into Sodium hypochlorite solution (0.1 g/l) for one hour, then rinse all glassware thoroughly with deionised water.
2. For individual testing of free and total Chlorine, the use of different sets of glassware is recommended (EN ISO 7393-2, 5.3)
3. Preparing the sample:
   When preparing the sample, the lost of Chlorine, e.g. by pipetting or shaking, must be avoided. The analysis must take place immediately after taking the sample.
4. The DPD colour development is carried out at a pH value of 6.2 to 6.5. The reagents therefore contain a buffer for the pH adjustment.
   Strong alkaline or acidic water samples must be adjusted between pH 6 and pH 7 before the reagent is added (use 0.5 mol/l Sulfuric acid resp. 1 mol/l Sodium hydroxide).
5. Exceeding the measuring range:
   Concentrations above:
   10 mg/l Chlorine using tablets
   4 mg/l Chlorine using liquid reagents
   2 mg/l using powder packs
   can lead to results showing 0 mg/l. In this case, the water sample must be diluted with water free of Chlorine. 10 ml of the diluted sample should be mixed with the reagent and the measurement repeated.
6. Turbidity (can lead to errors):
   The use of the DPD No. 1 tablet (method 100) in samples with high Calcium ion content* and/or high conductivity* can lead to turbidity of the sample and therefore incorrect measurements. In this case, the reagent tablet DPD No. 1 High Calcium should be used as an alternative. Even if turbidity does occur after the DPD No. 3 tablet has been added, this can be prevented by using the DPD No. 1 HIGH CALCIUM tablet.
   ** it is not possible to give exact values, because the development of turbidity depends on the nature of the sample.*
7. If ??? is displayed at a differentiated test result see page 146.

Oxidising agents such as Bromine, Ozone etc. interfere as they react in the same way as Chlorine.

Precision

An educated operator obtained under laboratory conditions exemplary for 2 different (one) standard solutions the following standard deviations using different lots of reagent:
Chlorine 0.20 ± 0.02 mg/l; 2.00 ± 0.05 mg/l

1.1 Methods

(1) (0) (0) Chlorine, differentiated determination with Tablets

0.01 – 6 mg/l Cl_2

Ø 24 mm

1. Fill a clean vial (24 mm Ø) with **10 ml of the water sample**, close tightly with the cap.
2. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

prepare Zero
press ZERO

3. Press **ZERO** key.
4. Remove the vial from the sample chamber and **empty it, leaving a few drops remaining in the vial.**
5. Add **one DPD No. 1 tablet** straight from the foil and crush the tablet using a clean stirring rod.
6. Add the water sample to the 10 ml mark.
7. Close the vial tightly with the cap and swirl several times until the tablet is dissolved.
8. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

Zero accepted
prepare T1
press TEST

9. Press **TEST** key.
10. Remove the vial from the sample chamber.
11. Add **one DPD No. 3 tablet** straight from the foil to the same water sample and crush the tablet using a clean stirring rod.

12. Close the vial tightly with the cap and swirl several times until the tablet is dissolved.

13. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

T1 accepted
prepare T2
press TEST

14. Press **TEST** key.

    Wait for a **reaction period of 2 minutes**.

Countdown
2:00

After the reaction period is finished the measurement starts automatically.

The result is shown in the display in:

***,** mg/l free Cl**
***,** mg/l comb Cl**
***,** mg/l total Cl**

mg/l free Chlorine
mg/l combined Chlorine
mg/l total Chlorine

Notes:

See page 23.

1.1 Methods

1 0 0 Chlorine, free with Tablets

0.01 – 6 mg/l Cl_2


Ø 24 mm

1. Fill a clean vial (24 mm Ø) with **10 ml of the water sample**, close tightly with the cap.

2. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

prepare Zero
press ZERO

3. Press **ZERO** key.

4. Remove the vial from the sample chamber and **empty it, leaving a few drops remaining in the vial.**

5. Add **one DPD No. 1 tablet** straight from the foil and crush the tablet using a clean stirring rod.

6. Add the water sample to the 10 ml mark.

7. Close the vial tightly with the cap and swirl several times until the tablet is dissolved.

8. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

Zero accepted
prepare Test
press TEST

9. Press **TEST** key.

The result is shown in the display in mg/l free Chlorine.

Notes:

See page 23.

1.1 Methods

1 0 0 Chlorine, total with Tablets

0.01 – 6 mg/l Cl_2

Ø 24 mm

1. Fill a clean vial (24 mm Ø) with **10 ml of the water sample**, close tightly with the cap.

2. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

prepare Zero
press ZERO

3. Press **ZERO** key.

4. Remove the vial from the sample chamber and **empty it, leaving a few drops remaining in the vial.**

5. Add **one DPD No. 1 tablet** and **one DPD No. 3 tablet** straight from the foil and crush the tablets using a clean stirring rod.

6. Add the water sample to the 10 ml mark.

7. Close the vial tightly with the cap and swirl several times until the tablets are dissolved.

8. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

Zero accepted
prepare Test
press TEST

9. Press **TEST** key.

   Wait for a **reaction period of 2 minutes**.

Countdown
2:00

After the reaction period is finished the measurement starts automatically.

The result is shown in the display in mg/l total Chlorine.

Notes:

See page 23.

1.1 Methods

1 0 1 Chlorine, differentiated determination with Liquid Reagent

0.02 – 4 mg/l Cl_2

1. Fill a clean vial (24 mm Ø) with **10 ml of the water sample**, close tightly with the cap.
2. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

prepare Zero
press ZERO

3. Press **ZERO** key.
4. Remove the vial from the sample chamber and **empty the vial**.
5. Fill the vial with drops of the same size by holding the bottle vertically and squeeze slowly:

   6 drops of DPD 1 buffer solution

   2 drops of DPD 1 reagent solution

6. Add the water sample to the 10 ml mark.
7. Close the vial tightly with the cap and swirl several times to mix the contents.
8. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

Zero accepted
prepare T1
press TEST

9. Press **TEST** key.
10. Remove the vial from the sample chamber.
11. **Add 3 drops of DPD 3 solution** to the same water sample.
12. Close the vial tightly with the cap and swirl several times to mix the contents.

1.1 Methods

13. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

T1 accepted
prepare T2
press TEST

14. Press **TEST** key.

Wait for a **reaction period of 2 minutes**.

Countdown
2:00

After the reaction period is finished the measurement starts automatically.

The result is shown in the display in:

***,** mg/l free Cl**
***,** mg/l comb. Cl**
***,** mg/l total Cl**

mg/l free Chlorine
mg/l combined Chlorine
mg/l total Chlorine

Notes:

1. After use replace the bottle caps securely noting the colour coding.
2. Store the reagent bottles in a cool, dry place ideally between 6°C and 10°C.
3. Also see page 23.

1.1 Methods

1 0 1 Chlorine, free with Liquid Reagent

0.02 – 4 mg/l Cl_2

Ø 24 mm

1. Fill a clean vial (24 mm Ø) with **10 ml of the water sample**, close tightly with the cap.

2. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

prepare Zero
press ZERO

3. Press **ZERO** key.

4. Remove the vial from the sample chamber and **empty the vial**.

5. Fill the vial with drops of the same size by holding the bottle vertically and squeeze slowly:

   6 drops of DPD 1 buffer solution

   2 drops of DPD 1 reagent solution

6. Add the water sample to the 10 ml mark.

7. Close the vial tightly with the cap and swirl several times to mix the contents.

8. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

Zero accepted
prepare Test
press TEST

9. Press **TEST** key.

   The result is shown in the display in mg/l free Chlorine.

Notes (free and total Chlorine):

1. After use replace the bottle caps securely noting the colour coding.
2. Store the reagent bottles in a cool, dry place ideally between 6°C and 10°C.
3. Also see page 23.

1.1 Methods

1 0 1 Chlorine, total with Liquid Reagent

0.02 – 4 mg/l Cl_2

Ø 24 mm

1. Fill a clean vial (24 mm Ø) with **10 ml of the water sample**, close tightly with the cap.

2. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

prepare Zero
press ZERO

3. Press **ZERO** key.

4. Remove the vial from the sample chamber and **empty the vial**.

5. Fill the vial with drops of the same size by holding the bottle vertically and squeeze slowly:

   6 drops of DPD 1 buffer solution

   2 drops of DPD 1 reagent solution

   3 drops of DPD 3 solution

6. Add the water sample to the 10 ml mark.

7. Close the vial tightly with the cap and swirl several times to mix the contents.

8. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

Zero accepted
prepare Test
press TEST

9. Press **TEST** key.

   Wait for a **reaction period of 2 minutes**.

Countdown
2:00

After the reaction period is finished the measurement starts automatically.

The result is shown in the display in mg/l total Chlorine.

1.1 Methods

(1) (1) (0) Chlorine, differentiated determination with Vario Powder Pack

0.02 – 2 mg/l Cl_2

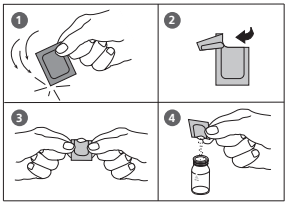
1. Fill a clean vial (24 mm Ø) with **10 ml of the water sample**, close tightly with the cap.

2. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

prepare Zero
press ZERO

3. Press **ZERO** key.

4. Remove the vial from the sample chamber.



5. Add the contents of **one Vario Chlorine FREE-DPD/ F10 Powder Pack** straight from the foil into the water sample.

6. Close the vial tightly with the cap and swirl several times to mix the contents (approx. 20 seconds).

7. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

Zero accepted
prepare T1
press TEST

8. Press **TEST** key.

9. Remove the vial from the sample chamber, empty the vial, rinse vial and cap several times and fill the vial with **10 ml of water sample**.

10. Add the contents of **one Vario Chlorine TOTAL-DPD / F10 Powder Pack** straight from the foil into the water sample.

11. Close the vial tightly with the cap and swirl several times to mix the contents (approx. 20 seconds).

1.1 Methods

12. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

T1 accepted
prepare T2
press TEST

13. Press **TEST** key.

Wait for a **reaction period of 3 minutes.**

Countdown
3:00

After the reaction period is finished the measurement starts automatically.

The result is shown in the display in:

***,** mg/l free Cl**
***,** mg/l comb. Cl**
***,** mg/l total Cl**

mg/l free Chlorine
mg/l combined Chlorine
mg/l total Chlorine

Notes:

See page 23.

1.1 Methods

1 1 0 Chlorine, free with Vario Powder Pack

0.02 – 2 mg/l Cl_2

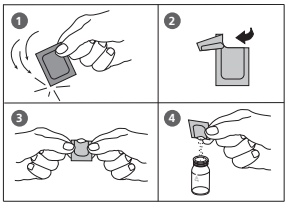
1. Fill a clean vial (24 mm Ø) with **10 ml of the water sample**, close tightly with the cap.

2. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

prepare Zero
press ZERO

3. Press **ZERO** key.

4. Remove the vial from the sample chamber.



5. Add the contents of **one Vario Chlorine FREE-DPD/ F10 Powder Pack** straight from the foil into the water sample.

6. Close the vial tightly with the cap and swirl several times to mix the contents (approx. 20 seconds).

7. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

Zero accepted
prepare Test
press TEST

8. Press **TEST** key.

The result is shown in the display in mg/l free Chlorine.

Notes:

See page 23.

1.1 Methods

(1) (1) (0) Chlorine, total with Vario Powder Pack

0.02 – 2 mg/l Cl_2

Ø 24 mm

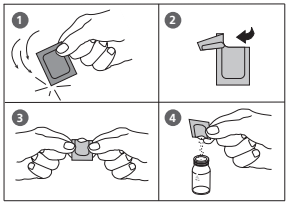
1. Fill a clean vial (24 mm Ø) with **10 ml of the water sample**, close tightly with the cap.

2. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

prepare Zero
press ZERO

3. Press **ZERO** key.

4. Remove the vial from the sample chamber.



5. Add the contents of **one Vario Chlorine TOTAL-DPD / F10 Powder Pack** straight from the foil into the water sample.

6. Close the vial tightly with the cap and swirl several times to mix the contents (approx. 20 seconds).

7. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

Zero accepted
prepare Test
press TEST

8. Press **TEST** key.
Wait for a **reaction period of 3 minutes**.

Countdown
3:00

After the reaction period is finished the measurement starts automatically.

The result is shown in the display in mg/l total Chlorine.

Notes:

See page 23.

1.1 Methods

1 2 0 Chlorine dioxide with Tablet

0.05 – 11 mg/l ClO_2

Chlorine diox T
>> with Cl
without Cl

The following selection is shown in the display:

>> with Cl

for the determination of Chlorine dioxide in the presence of Chlorine.

>> without Cl

for the determination of Chlorine dioxide in the absence of Chlorine.

Select the desired determination with the arrow keys [▲] and [▼]. Confirm with [↵] key.

1.1 Methods

Notes:

1. Vial cleaning:
   As many household cleaners (e.g. dishwasher detergent) contain reducing substances, the subsequent determination of Chlorine dioxide may show lower results. To avoid any measurement errors, only use glassware free of Chlorine demand.
   Preparation: Put all applicable glassware into Sodium hypochlorite solution (0.1 g/l) for one hour, then rinse all glassware thoroughly with deionised water.
2. Preparing the sample:
   When preparing the sample, the lost of Chlorine dioxide, e.g. by pipetting or shaking, must be avoided. The analysis must take place immediately after taking the sample.
3. The DPD colour development is carried out at a pH-value of 6.2 to 6.5. The reagent tablet therefore contains a buffer for the pH adjustment.
   Strong alkaline or acidic water samples must be adjusted between pH 6 and pH 7 before the tablet is added (use 0.5 mol/l Sulfuric acid resp. 1 mol/l Sodium hydroxide).
4. Exceeding the measuring range:
   Concentrations above 19 mg/l Chlorine dioxide can lead to results showing 0 mg/l. In this case, the water sample must be diluted with water free of Chlorine dioxide. 10 ml of the diluted sample should be mixed with the reagent and the measurement repeated.
5. If ??? is displayed at a differentiated test result see page 146.

Oxidising agents such as Chlorine, Ozone etc. interfere as they react in the same way as Chlorine dioxide.

Precision

An educated operator obtained under laboratory conditions exemplary for 2 different (one) standard solutions the following standard deviations using different lots of reagent:
0.40 ± 0.03 mg/l; 4.00 ± 0.12 mg/l

1.1 Methods

1 2 0 Chlorine dioxide in the presence of Chlorine

0.05 – 11 mg/l ClO_2

1. Fill a clean vial (24 mm Ø) with **10 ml of the water sample**, close tightly with the cap.
2. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

prepare Zero
press ZERO

3. Press **ZERO** key.
4. Remove the vial from the sample chamber and **empty it, leaving a few drops remaining in the vial.**
5. Add **one DPD No. 1 tablet** straight from the foil and crush the tablet using a clean stirring rod.
6. **Fill a second clean vial with 10 ml of water sample.**
7. Add **one GLYCINE tablet** straight from the foil and crush the tablet using a clean stirring rod.
8. Close the vial tightly with the cap and swirl several times until the tablet is dissolved.
9. **Transfer the contents of the second vial into the prepared vial.**
10. Close the vial tightly with the cap and swirl several times until the tablet is dissolved.
11. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

Zero accepted
prepare T1
press TEST

12. Press **TEST** key.

13. Remove the vial from the sample chamber, empty the vial, rinse vial and cap several times. Fill with **a few drops of water sample**.

14. Add **one DPD No. 1 tablet** straight from the foil and crush the tablet using a clean stirring rod.

15. Add the water sample to the 10 ml mark.

16. Close the vial tightly with the cap and swirl several times until the tablet is dissolved.

17. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

T1 accepted
prepare T2
press TEST

18. Press **TEST** key.

19. Remove the vial from the sample chamber.

20. Add **one DPD No. 3 tablet** straight from the foil to the same water sample and crush the tablet using a clean stirring rod.

21. Close the vial tightly with the cap and swirl several times until the tablet is dissolved.

22. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

T2 accepted
prepare T3
press TEST

23. Press **TEST** key.
Wait for a **reaction period of 2 minutes**.

Countdown
2:00

After the reaction period is finished the measurement starts automatically.

The result is shown in the display in:

***,** mg/l ClO_2 [Cl]**

Chlorine dioxide in mg/l Chlorine,
or
Chlorine dioxide in mg/l ClO_2.

***,** mg/l ClO_2**

***,** mg/l free Cl**
***,** mg/l comb. Cl**
***,** mg/l total Cl**

mg/l free Chlorine
mg/l combined Chlorine
mg/l total Chlorine

Notes:

See next page.

1.1 Methods

Notes: (Chlorine dioxide in the presence of Chlorine)

1. The conversion factor to convert Chlorine dioxide as Chlorine to Chlorine dioxide as ClO_2 is approximately 0.4 (more exactly 0.38).
   mg/l ClO_2 = mg/l ClO_2 [Cl] x 0.38

   ▲ ClO_2[Cl]
   ▼ ClO_2

   (Chlorine dioxide displayed as Chlorine units ClO_2 [Cl] has its origin in swimming poolwater treatment according to DIN 19643.)
2. The total Chlorine result given includes the contribution of the Chlorine dioxide (as Chlorine) reading. For true total Chlorine value subtract the Chlorine dioxide (as Chlorine) reading from the quoted total Chlorine reading.
3. Also see page 37.

1.1 Methods

1 2 0 Chlorine dioxide in absence of Chlorine

0.05 – 11 mg/l ClO_2

Ø 24 mm

1. Fill a clean vial (24 mm Ø) with **10 ml of the water sample**, close tightly with the cap.

2. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

prepare Zero
press ZERO

3. Press **ZERO** key.

4. Remove the vial from the sample chamber and **empty it, leaving a few drops remaining in the vial.**

5. Add **one DPD No. 1 tablet** straight from the foil and crush the tablet using a clean stirring rod.

6. Add the water sample to the 10 ml mark.

7. Close the vial tightly with the cap and swirl several times until the tablet is dissolved.

8. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

Zero accepted
prepare Test
press TEST

9. Press **TEST** key.

The result is shown in the display

***,** mg/l ClO_2 [Cl]**

as Chlorine dioxide in mg/l Chlorine,
or

***,** mg/l ClO_2**

as Chlorine dioxide in mg/l ClO_2.

Notes:

See page 37.

1.1 Methods

1 5 0 Copper with Tablet

0.05 – 5 mg/l Cu

Copper T >> diff free total	The following selection is shown in the display:
>> diff	for the differentiated determination of free, combined and total Copper.
>> free	for the determination of free Copper.
>> total	for the determination of total Copper.

Select the desired determination with the arrow keys [▲] and [▼]. Confirm with [↵] key.

Note:

1. If ??? is displayed at the diffentiated test result see page 146.

Precision

An educated operator obtained under laboratory conditions exemplary for 2 different (one) standard solutions the following standard deviations using different lots of reagent: 0.30 ± 0.03 mg/l; 3.50 ± 0.07 mg/l

1.1 Methods

1 5 0

Copper, differentiated determination

0.05 – 5 mg/l Cu

Ø 24 mm

prepare Zero
press ZERO

1. Fill a clean vial (24 mm Ø) with **10 ml of the water sample**, close tightly with the cap.
2. Place the vial in the sample chamber making sure that the ⨉ marks are aligned.
3. Press **ZERO** key.
4. Remove the vial from the sample chamber.
5. Add **one COPPER No. 1 tablet** straight from the foil to the water sample and crush the tablet using a clean stirring rod.
6. Close the vial tightly with the cap and swirl several times until the tablet is dissolved.
7. Place the vial in the sample chamber making sure that the ⨉ marks are aligned.

Zero accepted
prepare T1
press TEST

8. Press **TEST** key.
9. Remove the vial from the sample chamber.
10. Add **one COPPER No. 2 tablet** straight from the foil to the same water sample and crush the tablet using a clean stirring rod.
11. Close the vial tightly with the cap and swirl several times until the tablet is dissolved.
12. Place the vial in the sample chamber making sure that the ⨉ marks are aligned.

T1 accepted
prepare T2
press TEST

13. Press **TEST** key.

The result is shown in the display in:

***,** mg/l free Cu**
***,** mg/l comb Cu**
***,** mg/l total Cu**

mg/l free Copper
mg/l combined Copper
mg/l total Copper

1.1 Methods

1 5 0

Copper, free

0.05 – 5 mg/l Cu

Ø 24 mm

1. Fill a clean vial (24 mm Ø) with **10 ml of the water sample**, close tightly with the cap.

2. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

prepare Zero
press ZERO

3. Press **ZERO** key.

4. Remove the vial from the sample chamber.

5. Add **one COPPER No. 1 tablet** straight from the foil to the water sample and crush the tablet using a clean stirring rod.

6. Close the vial tightly with the cap and swirl several times until the tablet is dissolved.

7. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

Zero accepted
prepare Test
press TEST

8. Press **TEST** key.

The result is shown in the display in mg/l free Copper.

1.1 Methods

1 5 0

Copper, total

0.05 – 5 mg/l Cu

Ø 24 mm

1. Fill a clean vial (24 mm Ø) with **10 ml of the water sample**, close tightly with the cap.

2. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

prepare Zero
press ZERO

3. Press **ZERO** key.

4. Remove the vial from the sample chamber.

5. Add **one COPPER No. 1 tablet and one COPPER No. 2 tablet** straight from the foil to the water sample and crush the tablets using a clean stirring rod.

6. Close the vial tightly with the cap and swirl several times until the tablets are dissolved.

7. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

Zero accepted
prepare Test
press TEST

8. Press **TEST** key.

The result is shown in the display in mg/l total Copper.

1.1 Methods

1 5 3 Copper, free (Note 1) with Vario Powder Pack

0.05 – 5 mg/l Cu

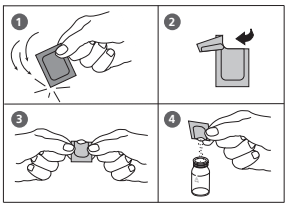
Ø 24 mm

1. Fill a clean vial (24 mm Ø) with **10 ml of the water sample**, close tightly with the cap.

2. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

prepare Zero
press ZERO

3. Press **ZERO** key.



4. Remove the vial from the sample chamber.

5. Add the contents of **one Vario Cu 1 F10 Powder Pack** straight from the foil into the water sample.

6. Close the vial tightly with the cap and swirl several times to mix the contents (Note 3).

7. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

Zero accepted
prepare Test
press TEST

8. Press **TEST** key.

   Wait for a **reaction period of 2 minutes**.

Countdown
2:00

After the reaction period is finished the measurement starts automatically.

The result is shown in the display in mg/l Copper

1.1 Methods

Notes:

1. For determination of total Copper digestion is required.
2. Extremely acid water samples (pH 2 or less) must be adjusted between pH 4 and pH 6 before the reagent is added (with 8 mol/l Potassium hydroxide solution KOH). Caution: pH values above 6 can lead to Copper precipitation.
3. Accuracy is not affected by undissolved powder.
4. Interferences:

Cyanid, CN^-	Cyanide prevents full colour development. Add 0.2 ml Formaldehyde to 10 ml water sample and wait for a reaction time of 4 minutes (Cyanide is masked). After this perform test as described. Multiply the result by 1.02 to correct the sample dilution by Formaldehyde.
Silber, Ag^+	If a turbidity remains and turns black, silver interference is likely. Add 10 drops of saturated Potassium chloride solution to 75 ml of water sample. Filtrate through a fine filter. Use 10 ml of the filtered water sample to perform test.

Precision

An educated operator obtained under laboratory conditions exemplary for 2 different (one) standard solutions the following standard deviations using different lots of reagent: 0.5 ± 0.03 mg/l; 3.5 ± 0.08 mg/l

1.1 Methods

1 6 0 Cyanuric acid with Tablet

2 – 160 mg/l Cys

Ø 24 mm

1. Fill a clean vial (24 mm ø) with **5 ml of the water sample and 5 ml deionised water (Note 1),** close tightly with the cap.

2. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

prepare Zero
press ZERO

3. Press **ZERO** key.

4. Remove the vial from the sample chamber.

5. Add **one CYANURIC ACID tablet** straight from the foil to the prepared water sample and crush the tablet using a clean stirring rod.

6. Close the vial tightly with the cap and swirl several times until the tablet is dissolved (Note 2, 3).

7. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

Zero accepted
prepare Test
press TEST

8. Press **TEST** key.

The result is shown in the display in mg/l Cyanuric acid.

1.1 Methods

Notes:

1. Use deionised water or tap water free of Cyanuric acid.
2. If Cyanuric acid is present a cloudy solution will occur.
   Small single particles are not necessarily caused by Cyanuric acid.
3. Dissolve the tablet completely (therefore swirl the vial approx. 1 minute).
   Un-dissolved particles of the tablet can cause results that are too high.

Precision

An educated operator obtained under laboratory conditions exemplary for 2 different (one) standard solutions the following standard deviations using different lots of reagent:
0 – 50 ± 10 mg/l; 50 – 100 ± 15 mg/l; 100 – 160 ± 20 mg/l

1.1 Methods

1 9 0 Hardness, Calcium with Tablet

50 – 900 mg/l $CaCO_3$

1. Fill a clean vial (24 mm ø) with **10 ml deionised water**.
2. Add **one CALCHECK tablet** straight from the foil to the deionised water and crush the tablet using a clean stirring rod.
3. Close the vial tightly with the cap and swirl gently several times until the tablet is dissolved.
4. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

prepare Zero
press ZERO

5. Press **ZERO** key.

   Wait for a **reaction period of 2 minutes**.

   After the reaction period is finished the measurement starts automatically.

Countdown
2:00

6. Remove the vial from the sample chamber.
7. Add **2 ml of the water sample** to the prepared vial: **Caution: Vial is filled to the top!**
8. Close the vial tightly with the cap and swirl several times (5x) to mix the contents.
9. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

Zero accepted
prepare Test
press TEST

10. Press **TEST** key.

    The result is shown in the display as Calcium Hardness.

1.1 Methods

Notes:

1. Strong alkaline or acidic water samples must be adjusted between pH 4 and pH 10 before the tablet is added (use 1 mol/l Hydrochloric acid resp. 1mol/l Sodium hydroxide).
2. The tolerance of the method is increasing with higher concentrations. When diluting samples, this should be take into account, always measuring in the first third of the range.
3. This method was developed from a volumetric procedure for the determination of calcium. Due to undefined conditions, the deviations from the standardised method may be greater.
4. It is convenient to use special vials with larger volume.
5. ▲ $CaCO_3$
   °dH
   °eH
   °fH
   ▼ °aH

Precision

An educated operator obtained under laboratory conditions exemplary for 2 different (one) standard solutions the following standard deviations using different lots of reagent: 500.00 ± 40.00 mg/l

1.1 Methods

1 9 1 Hardness, Calcium 2T with Tablet

0 – 500 mg/l $CaCO_3$

1. Fill a clean vial (24 mm Ø) with **10 ml of the water sample**, close tightly with the cap.
2. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

prepare Zero
press ZERO

3. Press **ZERO** key.
4. Remove the vial from the sample chamber.
5. Add **one CALCIO H No. 1 tablet** straight from the foil to the 10 ml water sample, crush the tablet using a clean stirring rod and dissolve the tablet completely.
6. Add **one CALCIO H No. 2 tablet** straight from the foil to the same water sample and crush the tablet using a clean stirring rod.
7. Close the vial tightly with the cap and swirl gently several times until the tablet is completely dissolved.
8. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

Zero accepted
prepare Test
press TEST

9. Press **TEST** key.

   Wait for a **reaction period of 2 minutes**.

Countdown
2:00

After the reaction period is finished the measurement starts automatically.

The result is shown in the display as Calcium Hardness.

1.1 Methods

Notes:

1. To optimise the readings an optional batch related calibration can be performed using Mode 40, see page 120.
2. Strong alkaline or acidic water samples must be adjusted to a pH-value between pH 4 and 10 before the tablets are added (use 1 mol/l Hydrochloride acid resp. 1 mol/l Sodium hydroxide).
3. For accurate test results exactly 10 ml of water sample must be taken for the test.
4. This method was developed from a volumetric procedure for the determination of Calcium Hardness. Due to undefined conditions, the deviations from the standardised method may be greater.
5. The tolerance of the method is increasing with higher concentrations. When diluting samples, this should be taken in account, always measuring in the first third of the range.
6. Interferences:
   - Magnesium hardness up to 200 mg/l $CaCO_3$ does not interfere.
   - Iron concentration above 10 mg/l may cause low results.
   - Zinc concentration above 5 mg/l may cause high results.
7. ▲ $CaCO_3$
   °dH
   °eH
   °fH
   ▼ °aH

Precision

An educated operator obtained under laboratory conditions exemplary for 2 different (one) standard solutions the following standard deviations using different lots of reagent:

100.00 ± 10.00 mg/l
500.00 ± 50.00 mg/l

1.1 Methods

2 0 0 Hardness, total with Tablet

2 – 50 mg/l $CaCO_3$

Ø 24 mm

1. Fill a clean vial (24 mm Ø) with **10 ml of the water sample**, close tightly with the cap.

2. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

prepare Zero
press ZERO

3. Press **ZERO** key.

4. Remove the vial from the sample chamber.

5. Add **one HARDCHECK P tablet** straight from the foil to the water sample and crush the tablet using a clean stirring rod.

6. Close the vial tightly with the cap and swirl gently several times until the tablet is dissolved.

7. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

Zero accepted
prepare Test
press TEST

8. Press **TEST** key.

   Wait for a **reaction period of 5 minutes**.

Countdown
5:00

After the reaction period is finished the measurement starts automatically.

The result is shown in the display as total Hardness.

1.1 Methods

Notes:

1. Strong alkaline or acidic water samples must be adjusted between pH 4 and pH 10 before the tablet is added (use 1 mol/l Hydrochloric acid resp. 1mol/l Sodium hydroxide).
2. Conversion table:

	mg/l $CaCO_3$	°dH	°fH	°eH
1 mg/l $CaCO_3$	----	0.056	0.10	0.07
1 °dH	17.8	----	1.78	1.25
1 °fH	10.0	0.56	----	0.70
1 °eH	14.3	0.80	1.43	----

3. ▲ $CaCO_3$
   °dH
   °eH
   °fH
   ▼ °aH

Precision

An educated operator obtained under laboratory conditions exemplary for 2 different (one) standard solutions the following standard deviations using different lots of reagent: 40.00 ± 3.00 mg/l.

1.1 Methods

2 0 1 Hardness, total HR with Tablet

20 – 500 mg/l $CaCO_3$

Ø 24 mm

1. Fill a clean vial (24 mm Ø) with **1 ml of the water sample** and **9 ml of deionised water**, close tightly with the cap.

2. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

prepare Zero
press ZERO

3. Press **ZERO** key.

4. Remove the vial from the sample chamber.

5. Add **one HARDCHECK P tablet** straight from the foil to the water sample and crush the tablet using a clean stirring rod.

6. Close the vial tightly with the cap and swirl gently several times until the tablet is dissolved.

7. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

Zero accepted
prepare Test
press TEST

8. Press **TEST** key.

   Wait for a **reaction period of 5 minutes**.

Countdown
5:00

After the reaction period is finished the measurement starts automatically.

The result is shown in the display as total Hardness.

1.1 Methods

Notes:

1. Strong alkaline or acidic water samples must be adjusted between pH 4 and pH 10 before the tablet is added (use 1 mol/l Hydrochloric acid resp. 1mol/l Sodium hydroxide).
2. Conversion table:

	mg/l $CaCO_3$	°dH	°fH	°eH
1 mg/l $CaCO_3$	----	0.056	0.10	0.07
1 °dH	17.8	----	1.78	1.25
1 °fH	10.0	0.56	----	0.70
1 °eH	14.3	0.80	1.43	----

3. ▲ $CaCO_3$
   °dH
   °eH
   °fH
   ▼ °aH

Precision:

An educated operator obtained under laboratory conditions exemplary for 2 different (one) standard solutions the following standard deviations using different lots of reagent:
400 ± 30 mg/l

1.1 Methods

2 1 0 Hydrogen peroxide with Tablet

0.03 – 3 mg/l H_2O_2

Ø 24 mm

1. Fill a clean vial (24 mm Ø) with **10 ml of the water sample**, close tightly with the cap.

2. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

prepare Zero
press ZERO

3. Press **ZERO** key.

4. Remove the vial from the sample chamber and **empty it, leaving a few drops remaining in the vial.**

5. Add **one HYDROGENPEROXIDE LR tablet** straight from the foil and crush the tablet using a clean stirring rod.

6. Add the water sample to the 10 ml mark.

7. Close the vial tightly with the cap and swirl several times until the tablet is dissolved.

8. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

Zero accepted
prepare Test
press TEST

9. Press **TEST** key.

   Wait for a **reaction period of 2 minutes**.

Countdown
2:00

After the reaction period is finished the measurement starts automatically.

The result is shown in the display in mg/l Hydrogen peroxide.

1.1 Methods

Notes:

1. Vial cleaning:
   As many household cleaners (e.g. dishwasher detergent) contain reducing substances, the subsequent determination of Hydrogen peroxide may show lower results. To avoid any measurement errors, only use glassware free of Chlorine demand.
   Preparation: Put all applicable glassware into Sodium hypochlorite solution (0.1 g/l) for one hour, then rinse all glassware thoroughly with deionised water.
2. Preparing the sample:
   When preparing the sample, the lost of Hydrogen peroxide, e.g. by pipetting or shaking, must be avoided. The analysis must take place immediately after taking the sample.
3. The DPD colour development is carried out at a pH value of 6.2 to 6.5. The reagent tablet therefore contains a buffer for the pH adjustment.
   Strong alkaline or acidic water samples must be adjusted between pH 6 and pH 7 before the tablet is added (use 0.5 mol/l Sulfuric acid resp. 1 mol/l Sodium hydroxide).
4. Exceeding the measuring range:
   Concentrations above 5 mg/l Hydrogen peroxide can lead to results showing 0 mg/l.
   In this case, the water sample must be diluted with water free of Hydrogen peroxide.
   10 ml of the diluted sample should be mixed with the reagent and the measurement repeated.

   Oxidising agents such as Chlorine, Ozone etc. interfere as they react in the same way as Hydrogen peroxide.

Precision

An educated operator obtained under laboratory conditions exemplary for 2 different (one) standard solutions the following standard deviations using different lots of reagent: 0.10 ± 0.02 mg/l; 1.00 ± 0.03 mg/l

1.1 Methods

2 1 5 Iodine with Tablet

0.05 – 3.6 mg/l I

Ø 24 mm

1. Fill a clean vial (24 mm Ø) with **10 ml of the water sample**, close tightly with the cap.
2. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

prepare Zero
press ZERO

3. Press **ZERO** key.
4. Remove the vial from the sample chamber and **empty it, leaving a few drops remaining in the vial.**
5. Add **one DPD No. 1 tablet** straight from the foil to the water sample and crush the tablet using a clean stirring rod.
6. Add the water sample to the 10 ml mark.
7. Close the vial tightly with the cap and swirl several times until the tablet is dissolved.
8. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

Zero accepted
prepare Test
press TEST

9. Press **TEST** key.

The result is shown in the display in mg/l Iodine.

1.1 Methods

Notes:

1. Oxidising reagents, such as Chlorine, Bromine, etc. interfere as they react in the same way as Iodine.

Precision

An educated operator obtained under laboratory conditions exemplary for 2 different (one) standard solutions the following standard deviations using different lots of reagent: 0.10 ± 0.02 mg/l; 1.00 ± 0.03 mg/l

1.1 Methods

2 2 0 Iron (Note 1) with Tablet

0.02 – 1 mg/l Fe

Ø 24 mm

1. Fill a clean vial (24 mm Ø) with **10 ml of the water sample**, close tightly with the cap.

2. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

prepare Zero
press ZERO

3. Press **ZERO** key.

4. Remove the vial from the sample chamber.

5. Add **one IRON LR tablet** straight from the foil to the water sample and crush the tablet using a clean stirring rod.

6. Close the vial tightly with the cap and swirl several times until the tablet is dissolved.

7. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

Zero accepted
prepare Test
press TEST

8. Press **TEST** key.

   Wait for a **reaction period of 5** minutes.

Countdown
5:00

After the reaction period is finished the measurement starts automatically.

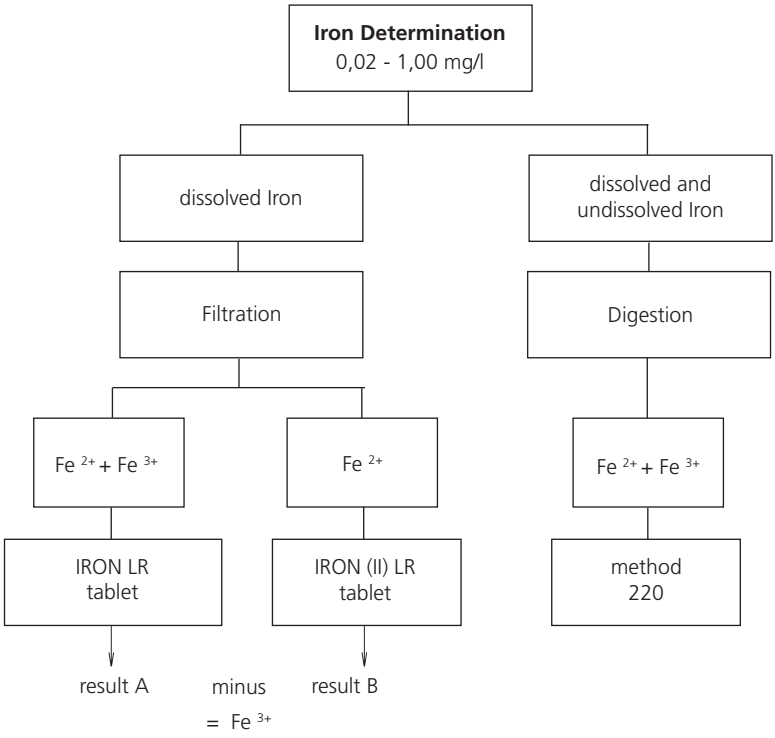
The result is shown in the display in mg/l Iron.

Precision
An educated operator obtained under laboratory conditions exemplary for 2 different (one) standard solutions the following standard deviations using different lots of reagent: 0.10 ± 0.01 mg/l; 1.00 ± 0.02 mg/l

1.1 Methods

Notes:

1. This method determines the total dissolved Iron as Fe^{2+} and Fe^{3+}.
2. For the determination of Fe^{2+} ions the IRON (II) LR tablet is used, as described above, instead of the IRON LR tablet.
3. For the determination of total dissolved and undissolved iron digestion is required.



Digestion procedure for the determination of total dissolved and undissolved iron.

1. Add 1 ml of concentrated sulfuric acid to 100 ml water sample. Heat and boil for 10 minutes or until all particles are dissolved. After cooling down, the sample is set to a pH-value of 3 to 6 by using ammonia solution. Refill with deionised water to the previous volume of 100 ml and mix well. 10 ml of this pre-treated solution is used for the following analysis. Perform as described by the selected test method.
2. Water which has been treated with organic compounds like corrosion inhibitors must be oxidised where necessary to break down the iron. Therefore add 1 ml concentrated sulfuric acid and 1 ml concentrated nitric acid to 100 ml water sample and boil to approx. half volume. After cooling down, proceed as described above.

1.1 Methods

2 9 0 Oxygen, active* with Tablet

0.1 – 10 mg/l O_2

Ø 24 mm

1. Fill a clean vial (24 mm Ø) with **10 ml of the water sample**, close tightly with the cap.

2. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

prepare Zero
press ZERO

3. Press **ZERO** key.

4. Remove the vial from the sample chamber.

5. Add **one DPD No. 4 tablet** straight from the foil to the water sample and crush the tablet using a clean stirring rod.

6. Close the vial tightly with the cap and swirl several times until the tablet is dissolved.

7. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

Zero accepted
prepare Test
press TEST

8. Press **TEST** key.

   Wait for a **reaction period of 2 minutes**.

Countdown
2:00

After the reaction period is finished the measurement starts automatically.

The result is shown in the display in mg/l active Oxygen.

1.1 Methods

Notes:

***Active oxygen is a synonym for a common disinfection (based on "oxygen") in Swimming Pool Treatment.**

1. When preparing the sample, the lost of Oxygen, e.g. by pipetting or shaking, must be avoided.
2. The analysis must take place immediately after taking the sample.

Precision

An educated operator obtained under laboratory conditions exemplary for 2 different (one) standard solutions the following standard deviations using different lots of reagent: 1.00 ± 0.10 mg/l; 10.00 ± 0.30 mg/l

1.1 Methods

3 0 0 Ozone with Tablet

0.02 – 2 mg/l O_3

Ozone (DPD) T **>> with Cl** **without Cl**

The following selection is shown in the display:

>> with Cl

for the determination of Ozone in the presence of Chlorine.

>> without Cl

for the determination of Ozone in the absence of Chlorine.

Select the desired determination with the arrow keys [▲] and [▼]. Confirm with [↲] key.

1.1 Methods

Notes:

1. Vial cleaning:
   As many household cleaners (e.g. dishwasher detergent) contain reducing substances, the subsequent determination of Ozone may show lower results. To avoid any measurement errors, only use glassware free of Chlorine demand.
   Preparation: Put all applicable glassware into Sodium hypochlorite solution (0.1 g/l) for one hour, then rinse all glassware thoroughly with deionised water.
2. Preparing the sample:
   When preparing the sample, the lost of Ozone, e.g. by pipetting or shaking, must be avoided. The analysis must take place immediately after taking the sample.
3. The DPD colour development is carried out at a pH-value of 6.2 to 6.5. The reagent tablet therefore contains a buffer for the pH adjustment.
   Strong alkaline or acidic water samples must be adjusted between pH 6 and pH 7 before the tablet is added (use 0.5 mol/l Sulfuric acid resp. 1 mol/l Sodium hydroxide).
4. Turbidity (can lead to errors):
   The use of the DPD No. 1 tablet in samples with high Calcium ion content* and/or high conductivity* can lead to turbidity of the sample and therefore incorrect measurements.
   **it is not possible to give exact values, because the developement of turbidity depends on the nature of the sample.*
5. Exceeding the measuring range:
   Concentrations above 6 mg/l Ozone can lead to results showing 0 mg/l. In this case, the water sample must be diluted with water free of Ozone. 10 ml of the diluted sample should be mixed with the reagent and the measurement repeated.
6. If `???` is displayed at the diffentiated test result see page 146.

Oxidising agents such as Bromine, Chlorine etc. interfere as they react in the same way as Ozone.

Precision

An educated operator obtained under laboratory conditions exemplary for 2 different (one) standard solutions the following standard deviations using different lots of reagent: 0.10 ± 0.02 mg/l; 1.50 ± 0.05 mg/l

1.1 Methods

3 0 0 Ozone, in the presence of Chlorine

0.02 – 2 mg/l O_3

Ø 24 mm

1. Fill a clean vial (24 mm Ø) with **10 ml of the water sample**, close tightly with the cap.
2. Place the vial in the sample chamber making sure that the ╳ marks are aligned.

prepare Zero
press ZERO

3. Press **ZERO** key.
4. Remove the vial from the sample chamber and **empty it, leaving a few drops remaining in the vial.**
5. Add **one DPD No. 1 tablet** and **one DPD No. 3 tablet** straight from the foil and crush the tablets using a clean stirring rod.
6. Add the water sample to the 10 ml mark.
7. Close the vial tightly with the cap and swirl several times until the tablets are dissolved.
8. Place the vial in the sample chamber making sure that the ╳ marks are aligned.

Zero accepted
prepare T1
press TEST

9. Press **TEST** key.
   Wait for a **reaction period of 2 minutes**.

Countdown
2:00

   After the reaction period is finished the measurement starts automatically.

10. Remove the vial from the sample chamber, empty the vial, rinse vial and cap several times. Fill the vial with **a few drops of water sample**.
11. Add **one DPD No. 1 tablet** and **one DPD No. 3 tablet** straight from the foil and crush the tablets using a clean stirring rod.

12. **Fill a second clean vial with 10 ml water sample.**

13. Add **one GLYCINE tablet** straight from the foil and crush the tablet using a clean stirring rod.

14. Close the vial tightly with the cap and swirl several times until the tablet is dissolved.

15. **Transfer the contents of the second vial into the prepared vial.**

16. Close the vial tightly with the cap and swirl several times until the tablets are dissolved.

17. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

T1 accepted
prepare T2
press TEST

18. Press **TEST** key.

Wait for a **reaction period of 2 minutes**.

Countdown
2:00

After the reaction period is finished the measurement starts automatically.

The result is shown in the display in:

***,** mg/l O_3**
***,** mg/l total Cl**

mg/l Ozone
mg/l total Chlorine

Notes:

See page 67

1.1 Methods

3 0 0 Ozone, in absence of Chlorine

0.02 – 2 mg/l O_3

Ø 24 mm

1. Fill a clean vial (24 mm Ø) **with 10 ml of the water sample**, close tightly with the cap.

2. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

prepare Zero
press ZERO

3. Press **ZERO** key.

4. Remove the vial from the sample chamber and **empty it, leaving a few drops remaining in the vial.**

5. Add **one DPD No. 1 tablet** and **one DPD No. 3 tablet** straight from the foil and crush the tablets using a clean stirring rod.

6. Add the water sample to the 10 ml mark.

7. Close the vial tightly with the cap and swirl several times until the tablets are dissolved.

8. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

Zero accepted
prepare Test
press TEST

9. Press **TEST** key.

   Wait for a **reaction period of 2 minutes**.

Countdown
2:00

After the reaction period is finished the measurement starts automatically.

The result is shown in the display in mg/l Ozone.

Notes:

See page 67

1.1 Methods

7 0 PHMB (Biguanide) with Tablet

2 – 60 mg/l PHMB

Ø 24 mm

1. Fill a clean vial (24 mm Ø) with **10 ml of the water sample**, close tightly with the cap.

2. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

prepare Zero
press ZERO

3. Press **ZERO** key.

4. Remove the vial from the sample chamber.

5. Add **one PHMB PHOTOMETER tablet** straight from the foil to the water sample and crush the tablet using a clean stirring rod.

6. Close the vial tightly with the cap and swirl several times until the tablet is dissolved.

7. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

Zero accepted
prepare Test
press TEST

8. Press **TEST** key.

   The result is shown in the display in mg/l PHMB.

1.1 Methods

Notes:

1. Clean vials with the brush immediately after analysis.
2. Vials and stirring rods may turn blue after prolonged use. In this case clean them with a laboratory detergent (see chapter 1.2.2 Cleaning of vials and accessories for analysis). Rinse vials and caps thoroughly with tap water and then with deionised water.
3. The test result is influenced by Hardness and Total Alkalinity.
   The calibration of this method was done using water with the following concentration:
   Ca-Hardness: 200 mg/l $CaCO_3$
   Total Alkalinity: 120 mg/l $CaCO_3$

Precision

An educated operator obtained under laboratory conditions exemplary for 2 different (one) standard solutions the following standard deviations using different lots of reagent: 50.00 ± 3.00 mg/l

1.1 Methods

3 1 9 Phosphate, ortho LR with Tablet

0.05 – 4 mg/l PO_4

Ø 24 mm

1. Fill a clean vial (24 mm ø) with **10 ml of the water sample**, close tightly with the cap.
2. Place the vial in the sample chamber making sure that the marks ⧖ aligned.

prepare Zero
press ZERO

3. Press **ZERO** key.
4. Remove the vial from the sample chamber.
5. Add **one PHOSPHATE No. 1 LR tablet** straight from the foil to the water sample and crush the tablet using a clean stirring rod.
6. Add **one PHOSPHATE No. 2 LR tablet** straight from the foil to the same water sample and crush the tablet using a clean stirring rod.
7. Close the vial tightly with the cap and swirl gently several times until the tablet is dissolved.
8. Place the vial in the sample chamber making sure that the marks ⧖ aligned.

Zero accepted
prepare Test
press TEST

9. Press **TEST** key.

Countdown
10:00

Wait for a **reaction period of 10 minutes**.

After the reaction period is finished the measurement starts automatically.

The result is shown in the display as ortho-Phosphate.

1.1 Methods

Notes

1. Only ortho-Phosphate ions PO_4^{3-} react.
2. The tablets must be added in the correct sequence.
3. The test sample should have a pH-value between 6 and 7.
4. Interferences:
   Higher concentrations of Cu, Ni, Cr (III), V (V) and W (VI) interfere due to their colour.
   Silicates do not interfere (masked by Citric acid in the tablets).
5. Conversion:
   mg/l P = mg/l PO_4 x 0.33
   mg/l P_2O_5= mg/l PO_4 x 0.75
6. ▲ PO_4
   P
   ▼ P_2O_5

Precision

An educated operator obtained under laboratory conditions exemplary for 2 different (one) standard solutions the following standard deviations using different lots of reagent: 0.3 ± 0.03 mg/l, 3.5 ± 0.07 mg/l

1.1 Methods

3 3 0 pH value 6.5 – 8.4 with Tablet

Ø 24 mm

1. Fill a clean vial (24 mm Ø) with **10 ml of the water sample**, close tightly with the cap.

2. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

prepare Zero
press ZERO

3. Press **ZERO** key.

4. Remove the vial from the sample chamber.

5. Add **one PHENOL RED PHOTOMETER tablet** straight from the foil to the water sample and crush the tablet using a clean stirring rod.

6. Close the vial tightly with the cap and swirl several times until the tablet is dissolved.

7. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

Zero accepted
prepare Test
press TEST

8. Press **TEST** key.

   The result is shown in the display as pH-value.

1.1 Methods

Notes:

1. For photometric determination of pH values only use PHENOL RED tablets in black printed foil pack and marked with PHOTOMETER.
2. Water samples with low values of Alkalinity-m (below 35 mg/l $CaCO_3$) may give wrong pH readings.
3. pH values below 6.5 and above 8.4 can produce results inside the measuring range. A plausibility test (pH-meter) is recommended.
4. The accuracy of the colorimetric determination of pH values depends on various boundary conditions (buffer capacity of the sample, salt content etc.).
5. Salt error
   Correction of test results (average values) for samples with salt content of:

Indicator	Salt content		
Phenol red	1 molar – 0.21	2 molar – 0.26	3 molar – 0.29

   The values of Parson and Douglas (1926) are based on the use of Clark and Lubs buffers.
   1 Mol NaCl = 58.4 g/l = 5.8 %

Precision

An educated operator obtained under laboratory conditions exemplary for 2 different (one) standard solutions the following standard deviations using different lots of reagent: 7.50 ± 0.01 mg/l

1.1 Methods

3 3 1 pH value 6.5 – 8.4 with Liquid Reagent

Ø 24 mm

1. Fill a clean vial (24 mm Ø) with **10 ml of the water sample**, close tightly with the cap.

2. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

prepare Zero
press ZERO

3. Press **ZERO** key.

4. Remove the vial from the sample chamber.

5. Fill the vial with drops of the same size by holding the bottle vertically and squeeze slowly:

   6 drops of PHENOL RED solution

6. Close the vial tightly with the cap and swirl several times to mix the contents.

7. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

Zero accepted
prepare TEST
press Test

8. Press **TEST** key.

   The result is shown in the display as pH-value.

1.1 Methods

Notes:

1. When testing chlorinated water the residual chlorine content can influence the colour reaction of the liquid reagent. This can be avoided (without interfering with the pH measurement) by adding a small crystal of Sodiumthiosulfate ($Na_2S_2O_3 \cdot 5\ H_2O$) to the sample before adding the PHENOL RED solution. PHENOL RED tablets already contain Thiosulfate.
2. Due to differing drop sizes, results can show a discrepancy in accuracy by comparison with tablets. This can be minimised by using a pipette (0.18 ml PHENOL RED solution is equivalent to 6 drops).
3. After use replace the bottle cap securely.
4. **Store the reagent in a cool, dry place ideally at between 6°C and 10°C.**

Precision

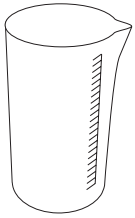
An educated operator obtained under laboratory conditions exemplary for 2 different (one) standard solutions the following standard deviations using different lots of reagent: 7.50 ± 0.01 mg/l

1.1 Methods

2 1 2

Sodium hypochlorite (Soda bleaching lye) with Tablet

0.2 – 16 % w/w NaOCl



Preparation:

1. Fill a 5 ml plastic syringe with the test solution, ensuring that all air bubbles are expelled. Transfer the 5 ml test solution slowly into a 100 ml beaker and dilute to the 100 ml mark with chlorine-free water. Mix thoroughly.
2. Fill a 5 ml plastic syringe with the diluted test solution (step 1) to the 1 ml mark, ensuring that all air bubbles are expelled. Transfer the 1 ml test solution slowly into a 100 ml beaker and dilute to the 100 ml mark with chlorine-free water. Mix thoroughly.

Performing test procedure:

1. Fill a clean vial (24 mm Ø) with **10 ml of the prepared water sample**, close tightly with the cap.
2. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

prepare Zero
press ZERO

3. Press **ZERO** key.
4. Remove the vial from the sample chamber.
5. Add **one CHLORINE HR (KI) tablet** straight from the foil to the water sample and crush the tablet using a clean stirring rod.
6. Add **one ACIDIFYING GP tablet** straight from the foil to the same water sample and crush the tablet using a clean stirring rod.
7. Close the vial tightly with the cap and swirl several times until the tablets are dissolved.

1.1 Methods

8. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

Zero accepted
prepare Test
press TEST

9. Press **TEST** key.

The result is shown in the display in % w/w as available chlorine present in the original sample of Sodium hypochlorite.

Notes:

1. Please pay attention when handling sodium hypochlorite. The material has a very strong alkalinity and can cause corrosion. Contact with eyes, skin and clothes etc. has to be avoided. Refer to the detailed information the producer has supplied with the product.
2. The tablets must be added in the correct sequence.
3. This method provides a fast and simple test. The test can be performed on site but the result will not be as precise as a laboratory method.
4. By strictly following the test procedure, an accuracy of ± 1 weight % can be achieved.

Precision

An educated operator obtained under laboratory conditions exemplary for 2 different (one) standard solutions the following standard deviations using different lots of reagent: 10 ± 0,5 % w/w

1.1 Methods

3 5 5 Sulfate with Tablet

5 – 100 mg/l SO_4


Ø 24 mm

1. Fill a clean vial (24 mm Ø) with **10 ml of the water sample**, close tightly with the cap.
2. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

prepare Zero
press ZERO

3. Press **ZERO** key.
4. Remove the vial from the sample chamber.
5. Add **one SULFATE T tablet** straight from the foil to the water sample and crush the tablet using a clean stirring rod.
6. Close the vial tightly with the cap and swirl several times until the tablet is dissolved.
7. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

Zero accepted
prepare Test
press TEST

8. Press **TEST** key.

The result is shown in the display in mg/l Sulfate.

1.1 Methods

Notes:

1. If Sulfate is present a cloudy solution will appear.

Precision

An educated operator obtained under laboratory conditions exemplary for 2 different (one) standard solutions the following standard deviations using different lots of reagent: 20.00 ± 1.00 mg/l; 80.00 ± 3.00 mg/l

1.1 Methods

3 6 0 Sulfate with Vario Powder Pack

2 – 100 mg/l SO_4

Ø 24 mm

1. Fill a clean vial (24 mm Ø) with **10 ml of the water sample**, close tightly with the cap.

2. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

prepare Zero
press ZERO

3. Press **ZERO** key.

4. Remove the vial from the sample chamber.

5. Add the contents of **one Vario Sulpha 4 / F10 Powder Pack** straight from the foil into the water sample.

6. Close the vial tightly with the cap and swirl several times to mix the contents.

7. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

Zero accepted
prepare Test
press TEST

8. Press **TEST** key.

   Wait for a reaction period of 5 minutes.

Countdown
5:00

After the reaction period is finished the measurement starts automatically.

The result is shown in the display in mg/l Sulfate.

1.1 Methods

Note:
1. If Sulfate ions are present a cloudy solution will appear.

Precision
An educated operator obtained under laboratory conditions exemplary for 2 different (one) standard solutions the following standard deviations using different lots of reagent: 10.00 ± 1.00 mg/l; 50.00 ± 2.00 mg/l

1.1 Methods

3 9 0 Urea with Tablet and Liquid Reagent

0.1 – 2.5 mg/l $(NH_2)_2CO$ / mg/l Urea

Ø 24 mm

1. Fill a clean vial (24 mm ø) with **10 ml of the water sample**, close tightly with the cap.

2. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

prepare Zero
press ZERO

3. Press **ZERO** key.

4. Remove the vial from the sample chamber.

5. Add **2 drops of Urea reagent 1** to the water sample (Note 9).

6. Close the vial tightly with the cap and swirl several times to mix the contents.

7. Add **1 drop of Urea Reagent 2** (Urease) to the same water sample (Note 9).

8. Close the vial tightly with the cap and swirl several times to mix the contents.

Countdown 1
5:00
Start: ↵

9. Press [↵] key.

   Wait for a **reaction period of 5 minutes**.

   After the reaction period is finished proceed as follows:

10. Add **one AMMONIA No. 1 tablet** straight from the foil to the prepared water sample and mix to dissolve with a clean stirring rod.

11. Add **one AMMONIA No. 2 tablet** straight from the foil to the same water sample and mix to dissolve with a clean stirring rod.

1.1 Methods

12. Close the vial tightly with the cap and swirl several times until the tablets are dissolved.

13. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

Zero accepted
prepare TEST
press TEST

14. Press **TEST** key.

Wait for a **reaction period of 10 minutes**.

Countdown
10:00

After the reaction period is finished the measurement starts automatically.

The result is shown in the display in mg/l Urea.

Notes:

1. The sample temperature should be between 20°C and 30°C.
2. Carry out the test at the latest one hour after sample taking.
3. Concentrations above 2 mg/l Urea can produce results inside the measuring range. In this case the water sample should be diluted with Urea free water and remeasured.
4. The tablets must be added in the correct sequence.
5. The AMMONIA No. 1 tablet will only dissolve completely after the AMMONIA No. 2 tablet has been added.
6. **Do not store reagent 1 (Urease) below 10°C; granulation is possible. Store reagent 2 (Urease) in the refrigerator at a temperature of 4°C to 8°C.**
7. Ammonia and chloramines are also measured during urea measurement.
8. Before analysing seawater samples, a measuring spoon of Ammonia Conditioning Powder must be added to the sample and swirled to dissolve before AMMONIA No. 1 tablet is added.
9. Fill the vial with drops of the same size by holding the bottle vertically and squeeze slowly.

Precision

An educated operator obtained under laboratory conditions exemplary for 2 different (one) standard solutions the following standard deviations using different lots of reagent: 1.50 ± 0.05 mg/l

1.2 Important notes

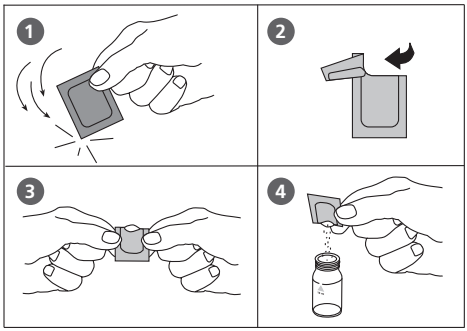
1.2.1 Correct use of reagents

The reagents must be added in the correct sequence.

Tablet reagents:
The tablet reagents should be added to the water sample straight from the foil without touching them with the fingers.

Liquid reagents:
Add drops of the same size to the water sample by holding the bottle vertically and squeezing slowly.
After use replace the bottle caps securely noting the colour coding.
Note recommendation for storage (e.g. cool and dry).

Powder Packs:



1.2.2 Cleaning of vials and accessories for analysis

Vials, caps and stirring rods should be cleaned thoroughly **after each analysis** to prevent interferences.

Procedure:

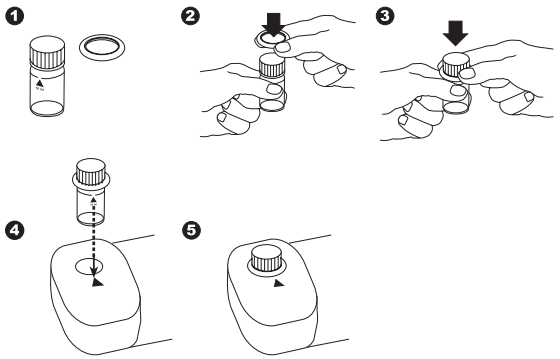
Clean vials and accessories after each analysis as soon as possible.

a. Clean vials and accessories with laboratory detergent
(e.g. Extran® MA 02 (neutral, phosphatic), Extran® MA 03 (alkaline, phosphate-free) from Merck KGaA).
b. Rinse thoroughly with tap water.
c. On demand (see Notes) perform special cleaning as required, e.g.: rinse with diluted Hydrochloric acid solution.
d. Rinse thoroughly with deionised water.

1.2.3 Guidelines for photometric measurements

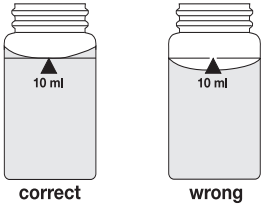
1. Vials, caps and stirring rods should be cleaned thoroughly after each analysis to prevent interferences. Even minor reagent residues can cause errors in the test result.
2. The outside of the vial must be clean and dry before starting the analysis. Clean the outside of the vials with a towel. Fingerprints or other marks will be removed.
3. If there is no defined vial for the blank, the zeroing and the test must be carried out with the same vial as there may be slight differences in optical performance between vials.
4. The vials must be positioned in the sample chamber for zeroing and test with the Δ mark on the vial aligned with the ∇ mark on the instrument.

Correct position of the vial (ø 24 mm):



5. Always perform zeroing and test with closed vial cap. Only use cap with sealing ring.
6. Bubbles on the inside of the vial may also lead to errors. To prevent this, remove the bubbles by swirling the vial before performing the test.
7. Avoid spillage of water in the sample chamber. If water should leak into the instrument housing, it can destroy electronic components and cause corrosion.
8. Contamination of the lens in the sample chamber can result in errors. Check at regular intervals and – if necessary – clean the light entry surfaces of the sample chamber using a moist cloth or cotton buds.
9. Large temperature differences between the instrument and the environment can lead to errors – e.g. due to the formation of condensation in the area of the lens or on the vial.
10. To avoid errors caused by stray light do not use the instrument in bright sunlight.

Correct filling of the vial:



1.2.4 Sample dilution techniques

Proceed as follows for accurate dilutions:

Pipette the water sample (see table) into a 100 ml volumetric flask and fill up to 100 ml mark with deionised water. Swirl to mix the contents.

Water sample [ml]	Multiplication-factor
1	100
2	50
5	20
10	10
25	4
50	2

Pipette the required volume of the diluted sample into the vial and proceed as described in the test methods.

Caution:

1. Dilution decreases accuracy.
2. Do not dilute water samples for measurement of pH-values. This will lead to incorrect test results. If "Overrange" is displayed use another instrument (e.g. pH-meter).

1.2.5 Correcting for volume additions

If a larger volume of acid or base is used to pre-adjust the pH-value, a volume correction of the displayed result is necessary.

Example:

For adjusting the pH-value of a 100 ml water sample 5 ml of acid had to be added. The corresponding displayed result is 10 mg/l.

Total volume = 100 ml + 5 ml = 105 ml
Correction factor = 105 ml / 100 ml = 1.05
Corrected result = 10 mg/l x 1.05 = 10.5 mg/l

Part 2

Operating manual

2.1 Operation

2.1.1 Commissioning

Before working with the photometer insert the rechargeable batteries and the Lithium battery (delivery contents). The rechargeable batteries are not charged. See chapter 2.1.2 Saving data – Important Notes, 2.1.3 Replacement of rechargeable batteries resp. Lithium battery. and 2.1.4 Charging the rechargeable batteries.

Before using the photometer perform the following settings in the Mode-Menu:

- MODE 10: select language
- MODE 12: set date and time
- MODE 34: perform „Delete data"
- MODE 69: perform "User m. init" to initialise the userpolynomial system

See chapter 2.4 Photometer settings.

2.1.2 Saving data – Important Notes

The Lithium battery saves data (stored results and photometer setting) if there is no power from the power supply from the rechargeable batteries or the mains adapter.
Recommendation: Exchange of the lithium battery every 5 years.
Note: When neither mains adapter nor batteries supply energy to the instrument, all stored data and settings will be lost, if the lithium battery is taken out.
Recommendation: Keep the instrument connected to mains adapter supply while changing the lithium battery.

2.1.3 Replacement of rechargeable batteries resp. Lithium-battery

1. Switch the instrument off.
2. If necessary remove vial from the sample chamber.
3. Place the instrument upside down on a clean and even surface.
4. Unscrew the two screws (A) of the battery compartment cover (B).
5. Lift off battery compartment cover.
6. If necessary remove old rechargeable batteries (C) and/or the Lithium-battery (D) (See 2.1.4).
7. Place 7 new rechargeable batteries and/or the Lithium-battery.
   Ensuring the correct polarity!
8. Replace the battery compartment cover.
9. Tighten the screws carefully.

CAUTION
Dispose of used rechargeable batteries and Lithium-batteries in accordance with all federal, state and local regulations.

2.1.4 Charging the rechargeable batteries

The rechargeable batteries are uncharged in the instrument. As soon as the photometer is connected with the mains adapter to the mains the rechargeable batteries are charged.

Empty rechargeable batteries should be charged in the instrument for at least 5 days. 10 charging and discharging cycles are necessary before the rechargeable batteries obtain their full capacity.

it is possible to operate the instrument with the adapter with or without inserted rechargeable batteries.

2.1.5 Fuse

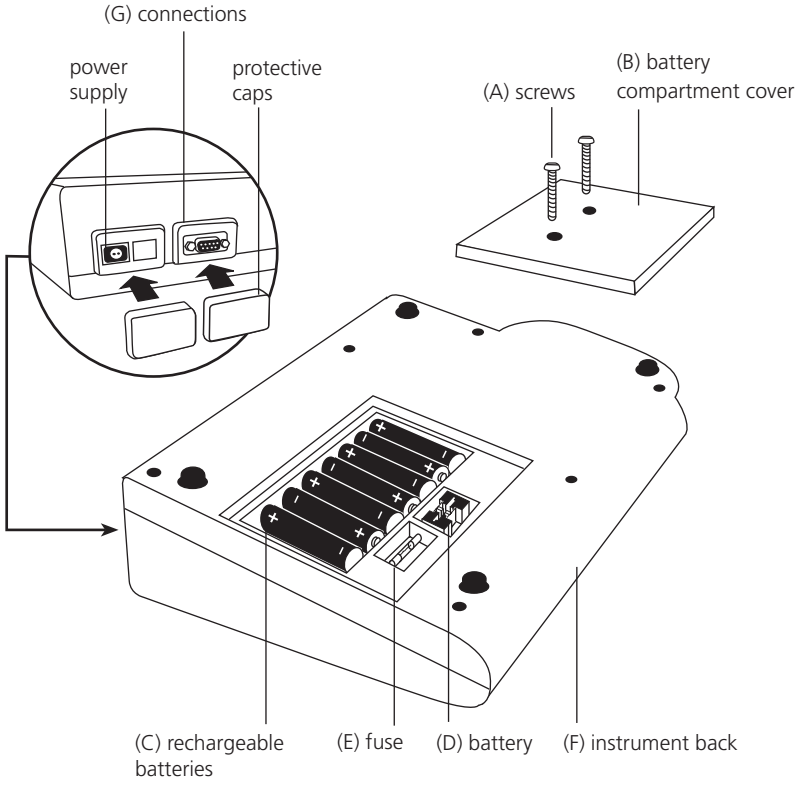
The instrument contains a fuse (E) (type: 1 A, inert, 20 mm).
If a replacement is necessary proceed as described in "Replacement of rechargeable batteries resp. Lithium-battery)". If the instrument can be operated with the mains adapter but not with the rechargeable batteries, the fuse could be defect (try new rechargeable batteries first).

2.1.6 Protective caps

If not used protect the two connections against damage (e.g. corrosion) caused by environmental influences (e.g. dust or splashing) keep the protective caps in place (G).

2.1.7 Instrument view

(A) screws
(B) battery compartment cover
(C) rechargeable batteries — 7 Ni-MH-rechargeable batteries (Type AA, 1100 mAh)
(D) battery — Lithium-battery (Type CR 2032, 3V)
(E) fuse — 1 A, inert, 20 mm
(F) instrument



2.2 Overview of function keys

Attention:
With the software-update V012.001.3.003.001 an "ESC-function" is implemented. If your keypad doesn't show an [Esc]-key please note that the grey key without a print (lowest key on the left) has the "ESC-function".

2.2.1 Overview

Switching the photometer on or off

Returning to selection of methods or previous menu

Function key: description in the text if key available

Function key: description in the text if key available

Function key: description in the text if key available


Confirming

Menu of photometer settings and further functions

Moving the cursor up or down

Storing of displayed test result

Performing Zero

Performing Test

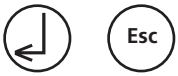

Displaying date and time / user-countdown

2.2.2 Displaying time and date:


Press [“clock”] key.

19:30:22 2006-06-15

The display shows:
After 15 seconds the photometer reverts to the previous display automatically



or press [↵] key or [ESC].

2.2.3 User countdown

With this function the operator is able to define his own countdown.

Press ["clock"] key.

19.30.20 2006-06-15

The display shows time and date:

Press ["clock"] key.

Countdown
mm : ss
99 : 99

The display shows:

Either press [↲] key to accept the last used user countdown

or

press any number key to start entering a new value.

The entry comprises two digits each.
Enter minutes and seconds
e.g.: 2 minutes, 0 seconds = [0][2][0][0].

Confirm with [↲] key.

Countdown
02:00
Start ↲

The display shows:

Start countdown with [↲] key.

After countdown has finished the photometer reverts to the previous display automatically.

2.3 Operation mode

Switch the photometer on by pressing the [ON/OFF] key.

Autotest ...

The photometer performs an electronic self-test.

2.3.1 Automatic switch off

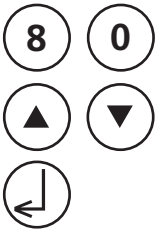
The instrument switches off automatically after 20 minutes. This is indicated 30 seconds before by a beeper. Press any key to avoid the instrument switching off.
As long as the instrument is working (for example countdown or printing) the automatic switch off is inactive.

2.3.2 Selecting a method

>>	**20 Acid demand**
	30 Alkalität-tot
	40 Aluminium

The display shows a selection:

There are two possibilities to select the required method:



a) enter method-number directly
e.g.: [8] [0] to select Bromine

b) press a row key [▼] or [▲] to select the required method from the displayed list.

Confirm with [↵] key.

2.3.2.1 Method Information (F1)

Use F1 key to switch between the compact and the detailed list for method selection.

100 Chlorine T
0.02-6 mg/l Cl2
Tablet
24 mm
DPD No 1
DPD No 3

Example:

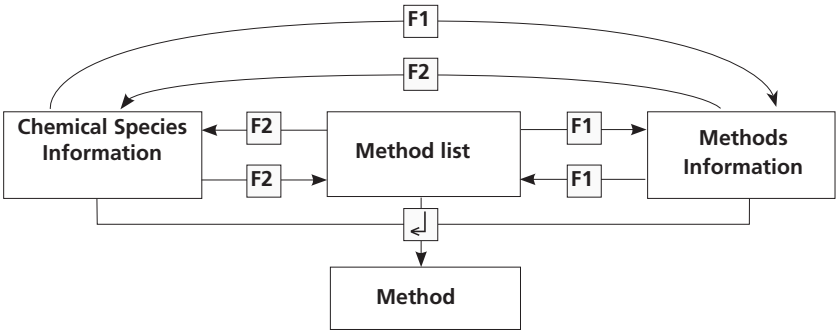
Line 1:	Method number, Method name
Line 2:	Range
Line 3:	Kind of reagent
Line 4:	Vial
Line 5-7:	Used reagent
tube:	reagent vial contained in tube test

2.3.2.2 Chemical Species Information

Press F2 key to display the available chemical species with range (see chapter 2.3.7 Changing chemical species).

319 Phosphate LR T
0.05-4 mg/l PO_4
0.02-1.3 mg/l P
0.04-3 mg/l P_2O_5

Line 1: Method number, Method name
Line 2: Range with chemical species 1
Line 3: Range with chemical species 2
Line 4: Range with chemical species 3

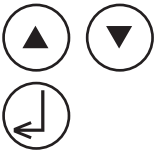


2.3.3 Differentiation

Differentiation is possible in some methods (e.g. Chlorine). The photometer then requires the type of determination.

Chlorine T
>> diff
free
total

Press arrow key [▼] or [▲] to select the required determination.



Confirm with [↵] key.

2.3.4 Performing Zero

prepare Zero
press ZERO

The display shows:

Prepare a clean vial as described in "Method" and place the vial in the sample chamber making sure that the ⧖ marks are aligned.

Press ZERO key.

Zero accepted
prepare Test
press TEST

The display shows:

2.3.5 Performing Tests

When zero calibration is complete, remove the vial from the sample chamber and perform the tests as described under "Method".

When the results have been displayed:

- with some methods you can change between different chemical species
- you can store and/or print out the results
- perform further analysis with the same zero
- select a new method

2.3.6 Ensuring reaction periods (countdown)

To ensure compliance with reaction periods a time delay is incorporated: the countdown. There are two kinds of countdowns:

Countdown
2:00

Start ↵

- Press [↵] key.
  Prepare water sample, start countdown with [↵] key and proceed as described in the mode description. The vial must not be placed in the sample chamber.

Countdown
1:59

- Press [TEST] key.
  Prepare the water sample as described in the method description and place the vial in the sample chamber. The display shows the countdown by pressing the [TEST] key and the countdown is started automatically. After the reaction period is finished the measurement starts automatically.

NOTE:

1. It is possible to finish the working countdown by pressing the [↵] key. In this case the operator is responsible for ensuring the necessary reaction period.
   Non-compliance with reaction periods leads to incorrect test results.
2. The time remaining is displayed continuously. The beeper indicates the last 10 seconds.

2.3.7 Changing chemical species

For some methods there is a possibility to change the chemical species of the test result. If the test result is displayed press arrow key [▲] or [▼].

Example:

319 Phosphate LR T -----[▼]----> 319 Phosphate LR T <---- [▼] ----- 319 Phosphate LR T
0.05-4 mg/l PO_4 0.02-1.3 mg/l P 0.04-3 mg/l P_2O_5
<---- [▲] ----- ----- [▲] ----->
1.00 mg/l PO_4 0.33 mg/l P 0.75 mg/l P_2O_5

If the species of a test result is changed, the displayed range is adjusted automatically.For an already stored result it is not possible to change the chemical species. The last displayed chemical species is kept by the instrument and will be displayed if this method is used the next time. If there is the possibility to change the chemical species for a method it is described in the manual. The arrows indicate the possible chemical species and are printed below the notes of the method:

▲ PO_4
P
▼ P_2O_5

2.3.8 Storing results

Press [STORE] while the test result is displayed.

Code-No.:
_ _ _ _ _ _

The display shows:

- We advise you to enter a numeric code (up to 6 places). (A Code No. can contain references to the operator or the sampling location.)

After entering confirm with [↵] key.

- If a code number is not necessary confirm by pressing [↵] directly. (The assignment for the Code No. is then 0 automatically.)

The entire data set is stored with date, time, Code No., method and test result.

Stored!

The display shows:

The test result is then shown again.

Note:

Storage: 900
free records left

The display shows the number of free data sets.

Storage: only 29
free records left

If there are less than 30 data sets free the display shows:

Clear the memory as soon as possible (see "Deleting stored results"). If memory capacity is used up it is impossible to save additional test results.

2.3.9 Printing results

If a printer is installed and switched on, it is possible to print out the test results (without saving it beforehand).

F3

Press [F3] key.

The entire data set is printed with date, time, Code No., method and test result. Printing example:

100 Chlorine T
0.02-6 mg/l Cl_2
Profi-Mode: no
2006-07-01 14:53:09
Test No.: 1
Code No.: 007
4.80 mg/l Cl_2

The test No. is an internal number that is set automatically if a test result is stored. It appears only on the print out.

2.3.10 Perform additional measurements

Test

To perform additional tests using the same method:

Zero accepted
prepare Test
press TEST

- Press [TEST] key

The display shows:

Test

Confirm with [TEST] key

or

Zero

- Press [ZERO] key to perform a new zero calibration.

prepare Zero
press ZERO

The display shows:

2.3.11 Selecting a new method

Press [ESC] key to return to method selection.

Or enter the required method number directly,
e.g. [1] [6] [0] for Cyanuric acid.

Confirm with [↲] key.

2.3.12 Measure absorbance

Range: –2600 mAbs to +2600 mAbs

Method-No.	Title
910	mAbs 530 nm
920	mAbs 560 nm
940	mAbs 610 nm

Select the desired wavelength from the method list or by entering the corresponding method number directly.

910 mAbs 530 nm
-2600 mAbs - + 2600 mAbs
prepare Zero
press ZERO

The display shows e.g.:

Always carry out zeroing using a filled (e.g. deionised water) vial.

Zero accepted
prepare Test
press TEST

The display shows:

Carry out measurement of the sample.

500 mAbs

The display shows e.g.:

TIP: To ensure complete reaction times the User Countdown may be helpful.

2.4 Photometer settings: Table of Mode-Functions

MODE-Function	No.	Description	Page
Calibration	40	Special method calibration	120
User calibration	45	Storage of user calibration	124
Clear calibration	46	Deleting user calibration	125
Clock	12	Setting date and time	108
Countdown	13	Switching the countdown on/off to ensure reaction times	109
Delete data	34	Deleting all stored results	119
Key beep	11	Switching the acoustic signal on/off to indicate key-pressing	107
Langelier	70	Calculation of Langelier saturation Index (Water Balance)	137
Temperature	71	Selection of °C or °F for Langelier Mode 70	138
Language	10	Selecting language	106
LCD contrast	80	Setting the display contrast	139
Method list	60	User method list, adaptation	127
Method list all on	61	User method list, switching on all methods	128
Method list all off	62	User method list, switching off all methods	128
Print	20	Printing all stored results	110
Print code no.	22	Print only results of a selected Code No. range	112
Print date	21	Print only results of a selected time period	111
Print method	23	Print only results of one selected method	113
Printing parameters	29	Setting of printing options	114
Profi-Mode	50	Switching the detailed operator instructions on/off	126
Signal beep	14	Switching the acoustic signal on/off to indicate end of Code No. range reading	109
Storage	30	Displaying all stored results	115
Storage Code No.	32	Displaying only results of a selected Code No. range	117
Storage date	31	Displaying only results of a selected time period	116
Storage method	33	Displaying only results of one selected method	118

MODE-Function	No.	Description	Page
System info	91	Information about the instrument e.g. current software version	139
User concentration	64	Entering the data necessary to run a user concentration method	129
User polynoms	65	Entering the data necessary to run a user polynomial	131
User methods clear	66	Delete all data of a user polynomial or of a concentration method	134
User methods print	67	Print out all data stored with mode 64 (concentration) or mode 65 (polynomial)	135
User methods init	69	Initialise the user method system (polynomial and concentration)	136

The selected settings are kept by the photometer even when switched off. To change photometer settings a new setting is required.

2.4.1 Blank because of technical requirements

2.4.2 Instrument basic settings 1

Selecting a language

Press [MODE] [1] [0] keys.

Confirm with [↵] key.

The display shows:

Press arrow key [▼] or [▲] to select the required language from the displayed list.

Confirm with [↵] key.

Key beep

Press [MODE] [1] [1] keys.

Confirm with [↵] key.

<Key Beep>
ON: 1 OFF: 0

The display shows:

- Press [0] key to switch the key beep off.

- Press [1] key to switch the key beep on.

Confirm with [↵] key.

Note:
In the case of methods with reaction periods, an acoustic signal still sounds during the last 10 seconds of the countdown even if the key beep is switched off.

Setting Date and time

Press [MODE] [1] [2] keys.

Confirm with [↵] key.

<clock>	
yy-mm-dd	hh:mm
_ _-_ _-_ _	_ _:_ _

The display shows:

The entry comprises two digits each.

yy-mm-dd	hh:mm
06-05-14	_ _:_ _

Enter year, month and day,
e.g.: 14. May 2006 = [0][6][0][5][1][4]

yy-mm-dd	hh:mm
06-05-14	15:07

Enter hours and minutes
e.g.: 3.07 p.m. = [1][5][0][7]

Confirm with [↵] key.

Note:
While confirming date and time with [↵] key the seconds are adjusted to zero automatically.

Countdown (Ensuring reaction periods)

Some methods require a reaction period. This reaction period is incorporated in the method as standard with the countdown function.
It is possible to switch the countdown off for all methods:

Press [MODE] [1] [3] keys.

Confirm with [↵] key.

<Countdown>
ON: 1 OFF: 0

The display shows:

- Press [0] key to switch the countdown off.

- Press [1] key to switch the countdown on.

Confirm with [↵] key.

Notes:

1. It is possible to interrupt the working countdown by pressing the [↵] key (application e.g. serial analysis). The "user countdown" is also available if the countdown is switched off.
2. If the countdown function is switched off, the operator is responsible for ensuring the necessary reaction period. **Non-compliance with reaction periods leads to incorrect test results.**

Signal beep

Performing a zero or a measurement takes 8 seconds. The photometer indicates the end of zeroing or measuring by a short beep.

Press [MODE] [1] [4] keys.

Confirm with [↵] key.

<Signal Beep>
ON: 1 OFF: 0

The display shows:

- Press [0] key to switch the signal beep off.

- Press [1] key to switch the signal beep on.

Confirm with [↲] key.

Note:
In the case of methods with reaction periods, an acoustic signal still sounds during the last 10 seconds of the countdown even if the key beep / signal beep is switched off.

2.4.3 Printing of stored results

Printing all results

Press [MODE] [2] [0] keys.

Confirm with [↲] key.

<Print>
print all data
Start: ↲
cancel: ESC

The display shows:

Press [↲] key for printing out all stored test results.

Test No.:

The display shows e.g.:

After printing the photometer goes back to <Mode Menu> automatically.

Note:
It is possible to cancel the entry by [ESC].
All stored data are printed out.

Printing results of a selected time period

Press [MODE] [2] [1] keys.

Confirm with [↲] key.

<Print>
sorted: date
from yy-mm-dd
__-__-__

The display shows:

Enter year, month and day for the first day of the required period, e.g.: 14 May 2006 = [0][6][0][5][1][4]

Confirm with [↲] key.

to yy-mm-dd
__-__-__

The display shows:

Enter year, month and day for the last day of the required period, e.g.: 19 May 2006 = [0][6][0][5][1][9]

Confirm with [↲] key.

from 2006-05-14
to 2006-05-19
Start: ↲
cancel: ESC

The display shows:

Press [↲] key and all stored results in the selected date range are printed.

After printing the photometer goes back to mode menu automatically.

Note:
It is possible to cancel the entry by [ESC].
If you want to print only results of one day enter the same date twice to determine the period.

Printing results of a selected Code No. range

Press [MODE] [2] [2] keys.

Confirm with [↵] key.

<Print>
sorted: Code No.
from _ _ _ _ _ _

The display shows:

Enter numeric code number (up to 6 places) for the first required Code No., e.g.: [1].

Confirm with [↵] key.

to _ _ _ _ _ _

The display shows:

Enter numeric code number (up to 6 places) for the last required Code No., e.g.: [1] [0].

Confirm with [↵] key.

from 000001
to 000010
Start: ↵
cancel: ESC

The display shows:

Press [↵] key and all stored results in the selected code number range are printed.

After printing the photometer goes back to mode menu automatically.

Note:
It is possible to cancel the entry by [ESC].
If you want to print only results of one code number enter the same code number twice.
If you want to print all results without code no. (code no. is 0) enter Zero [0] twice.

Printing results of one selected method

Press [MODE] [2] [3] keys.

Confirm with [↵] key.

<Print>
>>20 Acid demand T
30 Alkalinity-tot T
40 Aluminium T

The display shows:

Select the required method from the displayed list or enter the method number directly.

Confirm with [↵] key.

In case of differentiated methods select the required kind of determination and confirm with [↵] key.

<Print>
method
30 Alkalinity-tot T
Start: ↵
cancel: ESC

The display shows:

Press [↵] key and all stored results of the selected method are printed.

After printing the photometer goes back to mode menu automatically.

Printing Parameter

Press [MODE] [2] [9] keys.

Confirm with [↲] key.

```
<printing parameter>
1: Flow control
2: Baud rate

cancel:          ESC
```

The display shows:

Press [1] key to select "Flow control".

```
<Flow Control>
is: Hardware
select:          ↑ ↓
save:            ↲
end:             ESC
```

The display shows:

Press arrow key [▼] or [▲] to select the required Protocol (Xon/Xoff, Hardware, no control)

Confirm with [↲] key.

Finish with [ESC] key.
Flow Control will be set to the selection displayed at "is".

Press [2] key to select "baud rate".

```
<Baud rate>
is: 19200
select:          ↑ ↓
save:            ↲
cancel:          ESC
```

The display shows:

Press arrow key [▼] or [▲] to select the required baud rate. (600, 1200, 2400, 4800, 9600, 14400, 19200)

Confirm with [↲] key.

End with [ESC] key.

Back to Mode Menu with [ESC] key.

Back to Method selection with [ESC] key.

Note:
Select "Hardware" as Protocol and "19200" as baud rate if you use the printer DP 1012. Select "Hardware" as Protocol and "9600" as baud rate if you use the printer DPN 2335. For setting of the printer see chapter 2.5.1 Connection to a printer.

2.4.4 Recall / delete stored results

Recall all stored results

Press [MODE] [3] [0] keys.

Confirm with [↲] key.

<Storage>
display all data
Start: ↲ cancel: ESC
print: F3
print all: F2

The display shows:

The stored data sets are displayed in chronological order, starting with the latest stored test result.

- Press [↲] key and all stored results are displayed.
- Press [F3] key to print the displayed result.
- Press [F2] key to print all selected results.
- End with [ESC].
- Press arrow key [▼] to display the following test result.
- Press arrow key [▲] to display the previous test result.

no data

If there are no test results in memory the display shows:

Recall results of a selected time period

Press [MODE] [3] [1] keys.

Confirm with [↲] key.

<Storage>
sorted: date
from yy-mm-dd
__-__-__

The display shows:

Enter year, month and day for the first day of the required period, e.g.: 14 May 2006 = [0][6][0][5][1][4]

Confirm with [↲] key.

to yy-mm-dd
__-__-__

The display shows:

Enter year, month and day for the last day of the required period, e.g.: 19 May 2006 = [0][6][0][5][1][9]

Confirm with [↲] key.

from 2006-05-14
to 2006-05-19
Start: ↲ cancel: ESC
print: F3
print all: F2

The display shows:

- Press [↲] key and all stored results in the selected date range are displayed.
- Press [F3] key to print the displayed result.
- Press [F2] key to print all selected results.
- End with [ESC].

Note:
It is possible to cancel the entry by [ESC].
If you want to recall only results of one day enter the same date twice to determine the time period.

Recall results of a selected Code No. range

Press [MODE] [3] [2] keys.

Confirm with [↵] key.

<Storage>
sorted: Code No.
from _ _ _ _ _ _

The display shows:

Enter numeric code number (up to 6 places for the first required Code No., e.g.: [1]).

Confirm with [↵] key.

to _ _ _ _ _ _

The display shows:

Enter numeric code number (up to 6 places) for the last required Code No., e.g.: [1] [0].

Confirm with [↵] key.

from 000001
to 000010
Start: ↵ cancel: ESC
print: F3
print all: F2

The display shows:

- Press [↵] key and all stored results in the selected Code No. range are displayed.
- Press [F3] key to print the displayed result.
- Press [F2] key to print all selected results.
- End with [ESC].

Note:
It is possible to cancel the entry by [ESC].
If you want to recall only results of one code number enter the same code number twice.
If you want to recall all results without code no. (code no. is 0) enter Zero [0] twice.

Recall results of one selected method

Press [MODE] [3] [3] keys.

Confirm with [↲] key.

<Storage>
>>20 Acid demand T
30 Alkalinity-tot T
40 Aluminium T

The display shows:

Select the required method from the displayed list or enter the method number directly.

Confirm with [↲] key.

In case of differentiated methods select the required kind of determination and confirm with [↲] key.

<Storage>
method
30 Alkalinity-tot T
Start: ↲ cancel: ESC
print: F3
print all: F2

The display shows:

- Press [↲] key and all stored results of the selected method are displayed.
- Press [F3] key to print the displayed result.
- Press [F2] key to print all selected results.
- End with [ESC].

Delete stored results

Press [MODE] [3] [4] keys.

Confirm with [↵] key.

<Delete data>
Delete all data?
YES : 1 NO : 0

The display shows:

- Press [0] key to retain the data sets in memory.

- After pressing key [1] the following acknowledgment is displayed:

<Delete data>
Delete data ↵
Do not delete: ESC

Press [↵] key to delete.

ATTENTION:
All stored test results are deleted.

or cancel without deleting data by pressing [ESC] key.

Note:
All stored test results are deleted.

2.4.5 Calibration

Calcium Hardness Method 191 – Calibration of a method blank

Mode 4 0

Press [MODE] [4] [0] keys.

Confirm with [↵] key.

<Calibration>
1: M191 Ca-Hardness 2
2: M191 0 Jus. Reset

The display shows:

1

Press [1] key.

<Calibration>
M191 Calcium Hardness 2T
prepare ZERO
press ZERO

The display shows:

1. Fill a clean vial (24 mm Ø) with exactly **10 ml of deionised water,** close tightly with the cap.
2. Place the vial in the sample chamber making sure that the ⧖ marks are aligned.

Zero

3. Press **ZERO** key.
4. Remove the vial from the sample chamber.
5. Pipette 100 ml of water free of calcium to an appropriate beaker (note 2, 3).
6. Add **10 CALCIO H No. 1 tablets** straight from the foil to the 100 ml of water, crush the tablets using a clean stirring rod and dissolve the tablets completely.
7. Add **10 CALCIO H No. 2 tablets** straight from the foil to the same water, crush the tablets using a clean stirring rod and dissolve the tablets completely.

Countdown
2:00
start: ↵

8. Press [↵] key.

   Wait for a **reaction period of 2 minutes**.

After the reaction period is finished proceed as follows:

9. Rinse the vial (24 mm Ø) with the coloured sample from the beaker and fill with 10 ml of the sample.

prepare TEST **press TEST**	10. Press **TEST** key.
stored	The batch related method blank is saved.
	Press [↵] key, to go back to mode menu.

Notes:

1. If a new batch of CALCIO tablets is used a calibration of the method blank has to be performed to optimise the results.
2. Deionised or tap water
3. If no water free of Calcium is available these ions can be masked by using EDTA. Preparation: Add 50 mg (a spatula-tipful) EDTA to 100 ml water and dissolve.
4. To achieve the most accurate method blank it is important to adhere exactly to the sample volume of 100 ml.

Calcium Hardness Method 191 – Reset method blank to factory calibration

	Press [MODE] [4] [0] keys.
	Confirm with [↵] key.
<Calibration> **1: M191 Ca-Hardness 2** **2: M191 0 Jus. Reset**	The display shows:
	Press [2] key.
<Calibration> **M191 Calcium Hardness 2T** **Reset ?** **YES: 1, NO: 0**	The display shows:
	Press [0] key to keep the method blank.
	Press [1] key to erase the method blank and set the value back to factory calibration.
	The instrument goes back to mode menu automatically.

User Calibration

If a test method is user calibrated the method name is displayed inverse.

Procedure:

- Prepare a standard of known concentration and use this standard instead of the sample according to the test procedure.
- It is recommend to use well known standards which are formulated according to DIN EN, ASTM or other international norms or to use certified standards which are commercially available.
- After measuring this standard solution it is possible to change the displayed results to the required value.
- If a method uses a mathematic equation for the calculation of the result, it is only possible to calibrate the basic tests since all the other tests use the same polynomial.
- The same applies for some test procedures which use a polynomial from another test procedure.

Return to factory calibration:

If the user calibration is deleted the factory calibration is automatically activated.

Table

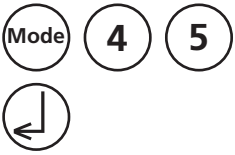
No.	Method	Recommended range for user calibration
20	Acid demand	1–3 mmol/l
30	Alkalinity-total	50–150 mg/l $CaCO_3$
40	Aluminium T	0.1–0.2 mg/l Al
50	Aluminium PP	0.1–0.2 mg/l Al
60	Ammonia T	0.3–0.5 mg/l N
80	Bromine	Calibration with basic test 100 Chlorine free
100	Chlorine T	0.5–1.5 mg/l Cl
101	Chlorine L	Calibration with basic test 100 Chlorine free
110	Chlorine PP	0.5–1 mg/l Cl_2
120	Chlorine dioxide	Calibration with basic test 100 Chlorine free
150	Copper T	0.5–1.5 mg/l Cu
153	Copper PP	2 mg/l Cu
160	Cyanuric acid	30–60 mg/l Cys
190	Hardness, Calcium	100–200 mg/l $CaCO_3$
191	Hardness, Calcium	100–200 mg/l $CaCO_3$
200	Hardness, total	15–25 mg/l $CaCO_3$
201	Hardness, total HR	Calibration with basic test 200 Hardness total
210	Hydrogen peroxide	Calibration with basic test 100 Chlorine free
215	Iodine	Calibration with basic test 100 Chlorine free

No.	Method	Recommended range for user calibration
220	Iron T	0.3–0.7 mg/l Fe
290	Oxygen, active	Calibration with basic test 100 Chlorine free
300	Ozone (DPD) T	Calibration with basic test 100 Chlorine free
330	pH- Value T	7.6–8.0
331	pH- Value L	7.6–8.0
70	PHMB	15–30 mg/l
319	Phosphate LR T	1–3 mg/l PO_4
212	Sodium hypochlorite	8 %
355	Sulfate T	50 mg/l SO_4
360	Sulfate PP	50 mg/l SO_4
390	Urea	1–2 mg/l CH_4N_2O

Store user calibration

100 Chlorine T
0.02-6 mg/l Cl2
0.90 mg/l free Cl2

Perform the required method as described in the manual using a standard of known concentration instead of the water sample.



If the test result is displayed press [MODE] [4] [5] keys and confirm with [↲] key.

<user calibration>
100 Chlorine T
0.02-6 mg/l Cl2
0.90 mg/l free Cl2
up: ↑, down: ↓
save: ↲

The display shows:

Pressing the arrow key [▲] once increases the displayed result.

Pressing the arrow key [▼] once decreases the displayed result.

Press keys till the displayed result corresponds to the value of the standard.

Confirm with [↲] key to store the new calibration factor.

Cancel user calibration by pressing [ESC] key.

Jus Factor
saved

The display shows:

100 Chlorine T
0.02-6 mg/l Cl2
1.00 mg/l free Cl2

Now the method name is displayed inverse and the test result is calculated with the new calibration factor.

Delete user calibration

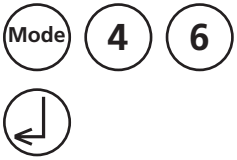
This chapter only applies for methods which can be user calibrated.

100 Chlorine T
0.02-6 mg/l Cl2

Select the required method.

prepare ZERO
press ZERO

Instead of zeroing the instrument press [MODE] [4] [6] keys and confirm with [↵] key.



<user calibration>
100 Chlorine T
0.02-6 mg/l Cl2
clear user
calibration?
YES: 1, NO: 0

The display shows:

Press [1] key to delete user calibration.

Press [0] key to keep the valid user calibration.

The instrument goes back to Zero-query automatically.

2.4.6 Lab functions

Reduced operator guidance => “Profi-Mode“

This function may be used for routine analyses with many samples of one method.
The following information is always stored in the methods:

a) Method
b) Range
c) Date and time
d) Differentiation of results
e) Detailed operator instruction
f) Compliance with reaction periods

If the Profi-Mode is active, the photometer provides only a minimum of operator instructions.
The criteria specified above in d, e, f are no longer included.

Press [MODE] [5] [0] keys in succession.

Confirm with [↵] key.

<Profi-Mode>
ON : 1 OFF : 0

The display shows:

- Press [0] key to switch the Profi-Mode off.

- Press [1] key to switch the Profi-Mode on.

switched off

The display shows:

or

switched on

Confirm with [↵] key.

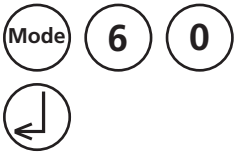
Note:
Storage of test results is possible. When results are stored the display also shows “Profi-Mode”.
The selected settings are kept by the photometer even when it is switched off. To change photometer setting a new setting is required.

2.4.7 User operations

User method list

After switching on the instrument a scroll list of all available methods is automatically shown in the display. To shorten this list according to the requirements of the user it is possible to create a user defined scroll list.
After performing the update successfully new methods are displayed in the user-method list automatically.
The program structure requires that this list must have at least one active (switched on) method. For this reason it is necessary to activate first all required methods and then to switch off the automatically activated one if this method is not required.

User method list, adaptation



Press [MODE] [6] [0] keys.

Confirm with [↲] key.

```
<method list>
selected: •
toggle: F2
save: ↲
cancel: ESC
```

The display shows:

Start with [↲] key.

```
<method list>
>> 30•Alkalinity-tot
   40•Aluminium
   50•Ammonia
....
```

The complete method list is displayed.

Methods with a point [•] behind the method number will be displayed in the method selection list. Methods without a point will not be displayed in the method selection list.

```
>> 30•Alkalinity-tot
```

Press key [▲] or [▼] to select the required method from the displayed list.

Switch with [F2] key between "active" [•] und "inactive" [ ].

```
>> 30 Alkalinity-tot
```

Select next method, activate or inactivate it and continue.

```
>> 30•Alkalinity-tot
```

Confirm with [↲] key.

Cancel without storing by pressing [ESC] key.

Recommendation:
If only a few methods are required it is recommended to perform Mode 62 first, followed by Mode 60.
All user Polynomials (1-25) and Concentrations (1-10) are displayed in the method list, although they are not programmed by the user. Non-programmed user methods can't be activated!

User method list, switch all methods on

This mode function activates all methods. After switching on the instrument a scroll list of all available methods is automatically shown in the display.

Press [MODE] [6] [1] keys.

Confirm with [↵] key.

<Mlist all on>
switch on all methods
YES: 1 NO: 0

The display shows:

- Press [1] key to display all methods in the method selection list.

- Press [0] key to keep the valid method selection list.

The instrument goes back to mode menu automatically.

User method list, switch all methods off

The program structure requires that the method list must have at least one active (switched on) method. For this reason the instrument activates one method automatically.

Press [MODE] [6] [2] keys.

Confirm with [↵] key.

<Mlist all off>
switch off all methods
YES: 1 NO: 0

The display shows:

- Press [1] key to display only one method in the method selection list.

- Press [0] key to keep the valid method selection list.

The instrument goes back to mode menu automatically.

User Concentration Methods

It is possible to enter and store up to 10 User Concentration Methods.
Therefor you need 2 to 14 standards of known concentration and one blank (deionised water or reagent blank value). The Standards should be measured with increasing concentrations and from the brightest to the darkest coloration.
The measuring range for „Underrange“ and „Overrange“ is defined with -2600 mAbs* and +2600 mAbs*. After selection of a method the concentration of the lowest and highest used standard is displayed as measuring range. The operation range should be within this range to achieve best results.

*1000 mAbs = 1 Abs = 1 E

Entering a User Concentration:

Mode 6 4

Press [MODE] [6] [4] keys.

Confirm with [↵] key.

Entry Procedure:

< User concentr.>
choose no.: ____
(850-859)

The display shows:

8 5 0

Enter a method number in the range from 850 to 859, e.g.: [8] [5] [0]

Confirm with [↵] key.

Overwrite conc. meth.?
YES: 1, NO: 0

Note:
if the entered number has already been used to save a concentration the display shows the query:

- Press [0] or [ESC] key to go back to method No. query.
- Press [1] key to start entry mode.

wavelength:
1: 530 nm
2: 560 nm
3: 610 nm

Enter the required wavelength, e.g.: [2] for 560 nm.

2

choose unit:
>>
mg/l
g/l
mmol/l
mAbs
µg/l
E
A
%

Press [▲] or [▼] keys to select the required unit.

Confirm with [↵] key.

choose resolution
1: 1
2: 0.1
3: 0.01
4: 0.001

③

Press the appropriate numerical key to select the required resolution, e.g.: for 0.01.

Note:
Please enter the required resolution according to the instrument pre-sets:

range	max. resolutions
0.000 ...9.999	0.001
10.00 ...99.99	0.01
100.0... 999.9	0.1
1000 ...9999	1

Measurement procedure with standards of known concentration:

< User concentr.>
prepare Zero
press ZERO

Zero

The display shows:

Prepare Zero and press [Zero] key.

Note:
Use deionised water or reagent blank value.

< User concentr.>
Zero accepted
S1: +_____
↲ | ESC | F1

The display shows:

Enter the concentration of the first standard;
e.g.: 0.05

- One step back with [ESC].
- Press [F1] key to reset numerical input.

⓪ . ⓪ ⑤

↲

Confirm with [↲] key.

< User concentr.>
S1: 0.05 mg/l
prepare
press TEST

The display shows:

Test

Prepare the first standard and press [Test] key.

S1: 0.05 mg/l
mAbs: 12 ↲

The display shows the input value and the measured absorption value. Confirm with [↲] key.

S1 accepted
S2: +_____
↲ | ESC | F1

Enter the concentration of the second standard;
e.g.: 0.1

- One step back with [ESC].
- Press [F1] key to reset numerical input.

⓪ . ①

↲

Confirm with [↲] key.

S2: 0.10 mg/l **prepare** **press TEST**	Prepare the second standard and press [Test] key.
S2: 0.10 mg/l **mAbs: 150** ↲	The display shows the input value and the measured absorption value. Confirm with [↲] key.
S2 accepted **S3: +_____** **↲ | ESC | F1 | Store**	**Note:** • Perform as described above to measure further standards. • The minimum of measured standards is 2. • The maximum of measured standards is 14 (S1 to S14).
Store	If all required standards or the maximum value of 14 standards are measured press [Store] key.
stored!	The display shows: The instrument goes back to the mode menu automatically. Now the concentration is stored in the instrument and can be recalled by entering its method number or selecting it from the displayed method list.

TIP:
Save all your concentration data in a written form because in case of power outage (e.g. changing the battery) all concentration data will be lost and must be entered again. You might want to use Mode 67 to transfer all concentration data to a PC.

User Polynomials

It is possible to enter and store up to 25 User Polynomials.
The program allows the user to apply a Polynomial up to the 5th degree:

$$y = A + Bx + Cx^2 + Dx^3 + Ex^4 + Fx^5$$

If only a Polynomial of a lower degree is necessary the other coefficients are specified as zero (0), e.g.: for the 2nd degree is D, E, F = 0.
The values of the coefficients A, B, C, D, E, F must be entered in an academic notation with maximal 6 decimal places, e.g.: 121,35673 = 1,213567E+02

Entering a User Polynomial:

Mode **6** **5**	Press [MODE] [6] [5] keys.
↲	Confirm with [↲] key.
<User polynoms> **choose no.: ____** **(800-824)**	The display shows:
8 **0** **0**	Enter a method number in the range from 800 to 824, e.g.: [8] [0] [0]

Confirm with [↵] key.

Overwrite polynom?
YES: 1, NO: 0

Note:
if the entered number has already been used to save a polynomial the display shows the query:

- Press [0] or [ESC] key to go back to method No. query.
- Press [1] key to start entry mode.

wavelength:
1: 530 nm
2: 560 nm
3: 610 nm

Enter the required wavelength, e.g.: [2] for 560 nm.

< User polynoms>
y = A+Bx+Cx²+Dx³+
Ex⁴+Fx⁵
A: +_____

- Press [▲] or [▼] key to change between plus and minus sign
- Enter data of the coefficient A including decimal point, e.g.: 1.32
- Press [F1] key to reset numerical input.

Confirm with [↵] key.

A: 1.32____ E+____

- Press [▲] or [▼] key to change between plus and minus sign
- Enter the exponent of the coefficient A, e.g.: 3

Confirm with [↵] key.

B: +_____

Successively the instrument queries the data for the other coefficients (B, C, D, E and F).

Note:
If zero [0] is entered for the value of the coefficient, the input of the exponent is omitted automatically.

Confirm every input with [↵] key.

measurement range
Min mAbs: +_____
Max mAbs: +_____

Enter measurement ranges from – 2600 bis + 2600 mAbs.

- Press [▲] or [▼] key to change between plus and minus sign.
- Enter the values in Absorbance (mAbs) for the upper limit (Max) and the lower limit (Min).

Confirm every input with [↵] key.

choose unit:
>>
mg/l
g/l
mmol/l
mAbs
µg/l
E
A
%

Press [▲] or [▼] keys to select the required unit.

Confirm with [↵] key.

choose resolution
1: 1
2: 0.1
3: 0.01
4: 0.001

③

Press the appropriate numerical key to select the required resolution, e.g.: [3] for 0.01.

Note:
Please enter the required resolution according to the instrument pre-sets:

range	max. resolutions
0.000 ...9.999	0.001
10.00 ...99.99	0.01
100.0... 999.9	0.1
1000 ...9999	1

stored!

The display shows:

The instrument goes back to the mode menu automatically.

Now the polynomial is stored in the instrument and can be recalled by entering its method number or selecting it from the displayed method list.

TIP:
Save all your polynomial data in a written form because in case of power outage (e.g. changing the battery) all polynomial data will be lost and must be entered again. You might want to use Mode 67 to transfer all polynomial data to a PC.

Delete User Methods (Polynomial or Concentration)

In principle a valid user method can be overwritten.
An existing user method (Polynomial or Concentration) can be totally deleted as well and is removed out of the method selection list:

Press [MODE] [6] [6] keys.

Confirm with [↵] key.

<User m. clear>
choose no.: _____
(800-824), (850-859)

The display shows:

Enter the number of the User Method you want to delete (in the range from 800 to 824 or 850 to 859),
e.g.: 800

Confirm with [↵] key.

M800
delete?
YES: 1, NO: 0

The query is displayed:

- Press [1] key to delete the selected User Method.

- Press [0] key to keep the valid User Method.

The instrument goes back to mode menu automatically.

Print Data of User Methods (Polynomials & Concentration)

With this Mode function all data (e.g. wavelength, unit ...) of stored user polynomials and concentration methods can be printed out or transferred with HyperTerminal to a PC.

Press [MODE] [6] [7] keys.

Confirm with [↲] key.

<User m. print>
Start: ↲

The display shows:

Press [↲] key to print out the data (e.g. wavelength, unit, ...) of all stored User Methods.

M800
M803
...

The display shows e.g.:

After data transfer the photometer goes back to mode menu automatically.

Initialise User Method System (Polynomials & Concentration)

Power loss will cause incoherent data. The user method system must be initialised with this mode function to set it to a predefined state.

ATTENTION:
all stored user methods (polynomial & concentration) are deleted with initialisation

Press [MODE] [6] [9] keys.

Confirm with [↲] key.

<User m. init>
Start: ↲

The display shows:

Confirm with [↲] key.

Initialising?
YES: 1, NO: 0

The query is displayed:

- Press [1] key to start initialisation.

- Press [0] key to to cancel without initialisation.

The instrument goes back to mode menu automatically.

2.4.8 Special functions

Langelier Saturation Index (Water Balance)

For calculation the following tests are required:

- pH-value
- Temperature
- Calcium hardness
- Total Alkalinity
- TDS (Total Dissolved Solids)

Run each test separately and note the results.
Calculate the Langelier Saturation Index as described:

Calculation of Langelier Saturation Index

With Mode 71 (see below) it is possible to select between degree Celsius or degree Fahrenheit.

Press [MODE] [7] [0] keys.

Confirm with [↵] key.

<Langelier>
temperature °C:
3°C <=T<=53°C
+_ _ _ _

The display shows:

Enter the temperature value (T) in the range between 3 and 53°C and confirm with [↵] key. If °F was selected, enter the temperature value in the range between 37 and 128°F.

calcium hardness
50<=CH<=1000
+_ _ _ _

The display shows:

Enter the value for Calcium hardness (CH) in the range between 50 and 1000 mg/l $CaCO_3$ and confirm with [↵] key.

tot. alkalinity
5<=TA<=800
+_ _ _ _

The display shows:

Enter the value for Total Alkalinity (TA) in the range between 5 and 800 mg/l $CaCO_3$ and confirm with [↵] key.

total dissol. solids
0<=TDS<=6000
+_ _ _ _

The display shows:

Enter the value for TDS (Total Dissolved Solids) in the range between 0 and 6000 mg/l and confirm with [↵] key.

pH value **0<=pH<=12** **+_ _ _ _**	The display shows:
	Enter the pH value in the range between 0 and 12 and confirm with [↲] key.
<Langelier> **Langelier** **saturation index** **0,00** **Esc ↲**	The display shows the Langelier Saturation Index. Press [↲] key to start new calculation. Return to mode menu by pressing [ESC] key.
	Operating error:
Examples:	Values out of defined range:
CH<=1000 mg/l CaCO3!	The entered value is too high.
CH>=50 mg/l CaCO3!	The entered value is too low.
	Confirm display message with [↲] key and enter a value in the defined range.

Notes:

If the index is zero the water is in perfect balance.
If the index is minus the water is aggressive and tends to be corrosive.
If the index is positive the water is non aggressive but has the ability of scale-forming.
For Swimming pool water an index value in the range of zero to + 0.3 is considered satisfactory.

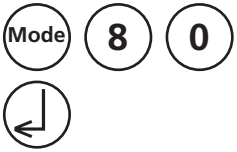
Selection of temperature unit

Entering the temperature value is possible in degree Celsius or degree Fahrenheit.
Therefore the following preselection is (once) required.

	Press MODE [7] [1] keys.
	Confirm with [↲] key.
<temperature> **1: °C 2: °F**	The display shows:
	Press [1] key to select degree Celsius.
	Press [2] key to select degree Fahrenheit.
	The instrument goes back to mode menu automatically.

2.4.9 Instrument basic settings 2

Adjusting display contrast



Press [MODE] [8] [0] keys.

Confirm with [↵] key.

```
<LCD contrast>
 ↑          ↓
```

The display shows:

Press arrow key [▲] to increase contrast of the LCD display.

Press arrow key [▼] to decrease contrast of the LCD display.

Press [Zero] key to increase contrast of the display about ten units.

Press [Test] key to decrease contrast of the display about ten units.

Confirm with [↵] key.

2.4.10 Instrument special functions /service

Photometer-Information

Press [MODE] [9] [1] keys.

Confirm with [↵] key.

```
<System-Info>
 Software:
V201.001.1.001.002
more: ▼, cancel: Esc
```

This method informs you about the current software version, about the current detected mains power supply, about the number of performed tests and free memory capacity.

Press arrow key [▼] to display the number of performed tests and free memory capacity.

```
<System-Info>
 Number of Tests:
139
free records left
999
cancel: Esc
```

Finish with [ESC] key.

2.5 Data transfer

Switch the photometer and the personal computer or printer off. Connect the photometer (RS232 interface) and the serial interface of the personal computer or printer using a cable in line with the specified assignment (see technical data). The cable for connection to a personal computer is included in delivery contents.

2.5.1 Connection to a printer

Printer with a serial connection are suitable for connection with the photometer (see chapter 3.4 Technical data interface).

A suitable paper tabel printer is the printer DPN 2335.

Before using the printer DPN 2335 with the Photometer you should change the following standard adjustments:
(Detailed information of changing the adjustment you will find in the printer manual).

Baudrate:	**9600**
Parity:	**None**
Data bits:	**8**

Note: The printer must be connected and switched on before printing.

Caution: Adjust printing parameter in Mode 29. See chapter 2.4.3 Printing of stored results.

2.5.2 Data transfer to a personal computer

Transferring test results from the photometer to a personal computer requires a transfer program, e.g. HyperTerminal.
Please find detailed information at our homepage in the download-area.

2.5.3 Internet-Updates

It is possible to update new software applications and additional languages via the internet.
Please find detailed information at our homepage in the download-area.

Please Note:
To prevent loss of stored test results store or print them out before performing an Update.

2.6 Blank because of technical requirements

Part 3

Enclosure

Part 3 Enclosure

3.1 Unpacking

Carefully inspect all items to ensure that every part of the list below is present and no visible damage has occurred during shipment. If there is any damage or something is missing, please contact your local distributor immediately.

3.2 Delivery content

Standard contents for PoolDirect:

☑

- ❑ 1 Photometer in plastic case
- ❑ 2 Protective caps for connections
- ❑ 1 Rechargeable battery set (7 Ni-MH cells; Type AA; 1100 mAh)
- ❑ 1 Lithium battery (CR 2032; 3V)
- ❑ 1 Mains adapter, 100 – 240 V, 50 – 60 Hz
- ❑ 1 Cable for connection to PC
- ❑ 3 Round vials with cap and seal, height 48 mm, ø 24 mm
- ❑ 1 Beaker, plastic, 100 ml
- ❑ 1 Cleaning brush
- ❑ 1 Stirring rod, plastic
- ❑ 1 Syringe, plastic, 5 ml
- ❑ 1 Instruction manual
- ❑ 1 Guarantee declaration

Tablet reagents for Chlorine, pH-value, Cyanuric acid (each 100 tests):

- ❑ DPD No. 1
- ❑ DPD No. 3
- ❑ PHENOL RED PHOTOMETER
- ❑ CYANURIC ACID

Further reagent sets are not part of the standard scope of delivery. Please see the General Catalogue for details of available reagent sets.

3.3 Blank because of technical requirements

3.4 Technical data

Display	Graphic Display (7-line, 21-characters)
Serial Interface	serial RS232 for printer- and PC-connection; 9-pin D-sub-mail connector, data format ASCII, 8-bit Data, no parity, 1 start-bit, 1 stop-bit, baudrate and protocol: adjustable
	Pin assignation: Pin 1 = free Pin 6 = free Pin 2 = Rx Data Pin 7 = RTS Pin 3 = Tx Data Pin 8 = CTS Pin 4 = free Pin 9 = free Pin 5 = GND
Light source	LEDs and photo sensor amplifier in protected cell compartment.
	Wavelength ranges: λ1 = 530 nm IF Δ λ = 5 nm λ2 = 560 nm IF Δ λ = 5 nm λ3 = 610 nm IF Δ λ = 6 nm IF = Interference filter
Photometric accuracy*	0.100 Abs ± 0.008 Abs 1.000 Abs ± 0.020 Abs
Operation	Acid and solvent resistant touch-sensitive keyboard with integral beeper as acoustic indicator.
Power supply	7 Ni-MH cells (Type AA with 1100 mAh);
Output:	external main adapter (Input: 100–240 V, 50–60 Hz; 15V=/530 mA) Lithium battery (CR 2032, 3V); for keeping data if there is no power supply from the rechargeable batteries or the main adapter
Auto off	20 minutes after last function, 30 seconds acoustical signal before switch off
Charging time	approx. 10 hours
Dimensions	approx. 265 x 195 x 70 mm (unit)
	approx. 440 x 370 x 140 mm (case)
Weight (unit)	approx. 1000 g (with main adapter and rechargeable batteries)
Working condition	5 – 40°C at max. 30–90% relative humidity (without condensation)
Language options	English, German, French, Spanish, Italian;
	further languages via Internet Update
Storage capaity	ca. 1000 data sets

** measured with standard solutions*

Subject to technical modification!

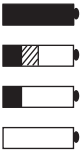
To ensure maximum accuracy of test results, always use the reagent systems supplied by the instrument manufacturer.

3.5 Abbreviations

Abbreviation	Definition
°C	degree Celsius (Centigrade)
°F	degree Fahrenheit °F = (°C x 1,8) + 32
°dH	degree German Hardness
°fH	degree French Hardness
°eH	degree English Hardness
°aH	degree American Hardness
Abs	Absorption unit
µg/l	(= ppb) Microgram per litre
mg/l	(= ppm) Milligram per litre
g/l	(= ppth) Gram per litre <
KI	Potassium Iodide
$K_{S\ 4.3}$	Acid demand to pH 4.3 – this method is similar to Total Alkalinity but converted into the unit "mmol/l", as the German DIN 38409 demand.
TDS	Total Dissolved Solids
LR	Low Range
MR	Medium Range
HR	High Range
C	Reagents from Chemetrics©
L	Liquid reagent
P	Powder (reagent)
PP	Powder Pack
T	Tablet
TT	Tube Test
DEHA	N,N-Diethylhydroxylamine
DPD	Diethyl-p-phenylendiamine
DTNB	Ellmans reagent
PAN	1-(2-Pyridylazo)-2-napthol
PDMAB	Paradimethylaminobenzaldehyde
PPST	3-(2-Pyridyl)-5,6-bis(4-phenylsulfonic acid)1,2,4-triazine
TPTZ	2,4,6-Tri-(2-Pyridyl)-1,3,5-triazine

3.6 Troubleshooting

3.6.1 Operating messages in the display / error display

Display	Possible Causes	Elimination
Overrange	reading is exceeding the range water sample is too cloudy to much light on the photo cell	if possible dilute sample or use other measuring range filtrate water sample seal on the cap? Repeat measurement with seal on the cap of the vial
Underrange	result is under the detection limit	indicate result with lower x mg/l x = low end of measuring range; if necessary use other analytical method
Storage-system error use Mode 34	mains power fails or is not connected	insert or change Lithium battery Delete Data with Mode 34.
capacity of rechargeable battery 	full capacity warning signal every 3 minutes warning signal every 12 seconds warning signal, the instrument switches itself off.	capacity of the rechargeable battery is too low charge the rechargeable battery; operate instrument with mains adapter
Jus Overrange E4	The user calibration is out of the accepted range	Please check the standard, reaction time and other possible faults. Repeat the user calibration.
Jus Underrange E4		
Overrange E1	The concentration of the standard is too high/too low, so that during user calibration the limit of the range was exceeded	Perform the test with a standard of higher/lower concentration
Underrange E1		
E40 user calibration not possible	If the display shows Overrange/ Underrange for a test result a user calibration is not possible	Perform the test with a standard of higher/lower concentration

Display	Possible Causes	Elimination
Zero not accepted	Light absorption is too great or too low	Refer to chapter 2.3.4: Performing Zero Clean sample chamber. Repeat zeroing.
??? Example 1 0,60 mg/l free Cl ??? comb Cl 0,59 mg/l total Cl Example 2 Underrange ??? comb Cl 1.59 mg/l total Cl Example 3 0,60 mg/l free Cl ??? comb Cl Overrange	The calculation of a value (e.g. combined Chlorine) is not possible.	Test procedure correct? If not --- repeat test Example: 1 The readings for free and total Chlorine are different, but considering the tolerances of each reading they are the same. For this reason the combined Chlorine is most likely zero. Example: 2 The reading for free Chlorine is under the detection limit. The instrument is not able to calculate the combined Chlorine. In this case the combined Chlorine is most likely the same as the total Chlorine. Example: 3 The reading for total chlorine is exceeding the range. The instrument is not able to calculate the combined chlorine. The test should be repeated
Error, absorbance z.B.: T2>T1	Fluoride calibration was not correct	Repeat calibration
Printer „Timeout“	printer switched off; no connection	Connect printer Check connections Switch printer on

3.6.2 General

Finding	Possible Causes	Elimination
Test result deviates from the expected	Chemical species not as required	Press arrow keys to select the required chemical species
No differentiation: e.g. for the Chlorine test there is no selection between differentiated, free or total.	Profi-Mode is switched on	Switch Profi-Mode off with Mode 50
The pre-programmed countdown is not displayed.	Countdown is not activated and/or the Profi-Mode is activated.	Switch the countdown on with Mode 13 and/or switch the Profi-Mode off with Mode 50.
It seems that a method is not available.	Method is not activated in the user method list.	Activate the required method in the user method list with Mode 60.
Instrument can be operated with the mains adapter but not with the rechargeable batteries.	Rechargeable batteries are not charged or defect. Fuse (Type A, inert, 20 mm) may be defect.	Charge rechargeable batteries or change them. If the problem still exists change fuse.

3.7 Declaration of CE-Conformity

The manufacturer: **Tintometer GmbH**

Schleefstraße 8 a
44287 Dortmund
Germany

declares, that this product

Product name: **PoolDirect**

Conforms with EN 61 326 for specific defined electromagnetic environment.
Conforms with EN 61 326 (domestic).

Dortmund, 06. August 2003

Cay-Peter Voss, Managing Director

Tintometer GmbH
Lovibond® Water Testing
Schleefstraße 8-12
44287 Dortmund
Tel.: +49 (0)231/94510-0
Fax: +49 (0)231/94510-20
sales@tintometer.de
www.tintometer.com

Germany

The Tintometer Limited
Lovibond House / Solar Way
Solstice Park / Amesbury, SP4 7SZ
Tel.: +44 (0)8452 264654
Fax: +44 (0)1980 625412
sales@tintometer.com
www.tintometer.com

UK

Tintometer AG
Hauptstraße 2
5212 Hausen AG
Tel.: +41 (0)56/4422829
Fax: +41 (0)56/4424121
info@tintometer.ch
www.tintometer.ch

Switzerland

Tintometer South East Asia
Unit C-11-3A, 3 Two Square,
No. 2, Jalan 19/1, Petaling Jaya,
46300, Selangor D.E
Tel.: +60 (0) 3 7955 4013
Fax: +60 (0) 3 7955 4014
lovibond.asia@tintometer.com
www.tintometer.com
Malaysia

Technical changes without notice
Printed in Germany 03/10