

MC500tm

Multi-Parameter Colorimeter



Instruction Manual

Safety precautions



CAUTION



Reagents are formulated exclusively for chemical analysis and must not be used for any other purpose. Keep reagents out of reach of children. Some reagents contain compounds 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 colorimeter. 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.



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, should not be used near the instrument.

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Part 1

Methods

1.1 Methods

1.1 Table of Methods

No.	Analysis	Reagent	Range	Displayed as	Method	λ [nm]	Page
20	Acid demand to pH 4.3 T	tablet	0.1-4	mmol/l	Acid/Indicator ^{1,2,5}	610	12
30	Alkalinity, total T	tablet	5-200	mg/l CaCO ₃	Acid/Indicator ^{1,2,5}	610	14
35	Alkalinity-p T	tablet	5-500	mg/l CaCO ₃	Acid/Indicator ^{1,2,5}	560	16
40	Aluminum T	tablet	0.01-0.3	mg/l Al	Eriochrome Cyanine R ²	530	18
50	Aluminum PP	PP + liquid	0.01-0.25	mg/l Al	Eriochrome Cyanine R ²	530	20
60	Ammonium T	tablet	0.02-1	mg/l N	Indophenol blue ^{2,3}	610	22
62	Ammonium PP	PP	0.01-0.8	mg/l N	Salicylate ²	660	24
65	Ammonium LR TT	tube test	0.02-2.5	mg/l N	Salicylate ²	660	26
66	Ammonium HR TT	tube test	1-50	mg/l N	Salicylate ²	660	28
85	Boron T	tablet	0.1-2	mg/l B	Azomethine ³	430	30
80	Bromine T	tablet	0.05-13	mg/l Br ₂	DPD ⁵	530	32
90	Chloride T	tablet	0.5 - 25	mg/l Cl	Silver nitrate/turbidity	530	34
100	Chlorine T *	tablet	0.01-6	mg/l Cl ₂	DPD ^{1,2,3}	530	36, 38
101	Chlorine L *	liquid	0.02-4	mg/l Cl ₂	DPD ^{1,2,3}	530	36, 42
110	Chlorine PP *	PP	0.02-2	mg/l Cl ₂	DPD ^{1,2}	530	36, 46
120	Chlorine dioxide T	tablet	0.05-11	mg/l ClO ₂	DPD, Glycine ^{1,2}	530	50
105	Chlorine HR (KI) T	tablet	5-200	mg/l Cl ₂	KI/Acid ⁵	530	56
130	COD LR TT	tube test	0 - 150	mg/l O ₂	Dichromate/H ₂ SO ₄ ^{1,2}	430	58
131	COD MR TT	tube test	0 - 1500	mg/l O ₂	Dichromate/H ₂ SO ₄ ^{1,2}	610	60
132	COD HR TT	tube test	0 - 15	g/l O ₂	Dichromate/H ₂ SO ₄ ^{1,2}	610	62
150	Copper T *	tablet	0.05-5	mg/l Cu	Biquinoline ⁴	560	64
153	Copper PP	PP	0.05-5	mg/l Cu	Bicinchoninate	560	68
157	Cyanide	PP + liquid	0.01-0.5	mg/l CN	Pyridine-barbituric acid ¹	580	70
160	Cyanuric acid T	tablet	2-160	mg/l Cys	Melamine	530	72
165	DEHA T	tablet + liquid	20-500	µg/l DEHA	PPST ³	560	74
167	DEHA PP	PP + liquid	20-500	µg/l DEHA	PPST ³	560	76
170	Fluoride L	liquid	0.05-2	mg/l F	SPADNS ²	580	78
190	Hardness, Calcium T	tablet	50-900	mg/l CaCO ₃	Murexide ⁴	560	80

* = free, combined, total; PP = powder pack; T = tablet;
 L = liquid; TT = tube test; LR = low range; MR = middle range; HR = high range;
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1.1 Methods

1.1 Table of Methods

No.	Analysis	Reagent	Range	Displayed as	Method	λ [nm]	Page
200	Hardness, total T	tablet	2-50	mg/l CaCO_3	Metallphthalein ³	560	82
201	Hardness, total HR T	tablet	20-500	mg/l CaCO_3	Metallphthalein ³	560	84
205	Hydrazine P	powder	0.05-0.5	mg/l N_2H_4	4-(Dimethyl-amino)-benzaldehyde ³	430	86
206	Hydrazine L	liquid	0.01-0.6	mg/l N_2H_4	4-(Dimethyl-amino)-benzaldehyde ³	430	88
207	Hydrazine C	Vacu-vial	0.01-0.7	mg/l N_2H_4	PDMAB	430	90
210	Hydrogen peroxide	tablet	0.03-3	mg/l H_2O_2	DPD/catalyst ⁵	530	92
215	Iodine T	tablet	0.05-3.6	mg/l I	DPD ⁵	530	94
220	Iron T	tablet	0.02-1	mg/l Fe	PPST ³	560	96, 98
222	Iron PP	PP	0.02-3	mg/l Fe	1,10-Phenanthroline ³	530	96, 100
223	Iron (TPTZ) PP	PP	0.02-1.8	mg/l Fe	TPTZ	580	96, 102
240	Manganese T	tablet	0.2-4	mg/l Mn	Formaldehyde	530	104
242	Manganese LR PP	PP + liquid	0.01-0.7	mg/l Mn	PAN	560	106
243	Manganese HR PP	PP + liquid	0,1-18	mg/l Mn	Periodate oxidation ²	530	108
250	Molybdate T	tablet	1-50	mg/l MoO_4	Thioglycolate ⁴	430	110
252	Molybdate HR PP	PP	0.5-66	mg/l MoO_4	Mercaptoacetic acid	430	112
265	Nitrate TT	tube test	1-30	mg/l N	Chromotropic acid	430	114
270	Nitrite T	tablet	0.01-0.5	mg/l N	N-(1-Naphthyl)-ethylenediamine ^{2,3}	560	116
272	Nitrite LR PP	PP	0.01-0.3	mg/l N	Diazotization	530	118
280	Nitrogen, total LR TT	tube test	0.5-25	mg/l N	Persulfate digestion method	430	120
281	Nitrogen, total HR TT	tube test	5-150	mg/l N	Persulfate digestion method	430	122
290	Oxygen, active T	tablet	0.1-10	mg/l O_2	DPD	530	124
292	Oxygen, dissolved	Vacu-vial	10-800	$\mu\text{g/l O}_2$	Rhodazine D TM	530	126
300	Ozone (DPD) T	tablet	0.02-1	mg/l O_3	DPD/Glycine ⁵	530	128
70	PHMB T	tablet	2-60	mg/l PHMB	Buffer/Indicator	560	134

* = free, combined, total; PP = powder pack; T = tablet;

L = liquid; TT = tube test; LR = low range; MR = middle range; HR = high range;

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1.1 Methods

1.1 Table of Methods

No.	Analysis	Reagent	Range	Displayed as	Method	λ [nm]	Page
320	Phosphate, T ortho LR	tablet	0.05-4	mg/l PO ₄	Ammonium-molybdate ^{2,3}	660	136, 138
321	Phosphate, ortho HR T	tablet	1-80	mg/l PO ₄	Vanado-molybdate ²	430	136, 140
323	Phosphate, PP ortho	PP	0.06-2.5	mg/l PO ₄	Ascorbic acid ²	660	136, 142
324	Phosphate, ortho TT	tube test	0.06-5	mg/l PO ₄	Ascorbic acid ²	660	136, 144
327	Phosphate 1 C, ortho	Vacu-vial	5-40	mg/l PO ₄	Vanado-molybdate ²	430	136, 146
328	Phosphate 2 C, ortho	Vacu-vial	0.05-5	mg/l PO ₄	Stannous chloride ²	660	136, 148
325	Phosphate, hydr. TT	tube test	0.02-1.6	mg/l P	Acid digestion, Ascorbic acid ²	660	136, 150
326	Phosphate, total TT	tube test	0.02-1.1	mg/l P	Acid persulf digestion, Ascorbic acid ²	660	136, 152
329	pH-Value LR T	tablet	5.2-6.8	—	Bromocresolpurple ⁵	560	154
330	pH-Value T	tablet	6.5-8.4	—	Phenolred ⁵	560	156
331	pH-Value L	liquid	6.5-8.4	—	Phenolred ⁵	560	158
332	pH-Value HR T	tablet	8.0-9.6	—	Thymolblue ⁵	560	160
340	Potassium T	tablet	0.7-12	mg/l K	Tetraphenylborate-Turbidity ⁴	430	162
350	Silica T	tablet	0.05-4	mg/l SiO ₂	Silicomolybdate ^{2,3}	660	164
351	Silica LR PP	PP	0.1-1.6	mg/l SiO ₂	Heteropolyblue ²	660	166
352	Silica HR PP	PP	1-90	mg/l SiO ₂	Silicomolybdate ²	430	168
212	Sodium hypochlorite T	tablet	0.2-16	% NaOCl	Potassium iodide ⁵	530	170
355	Sulfate T	tablet	5-100	mg/l SO ₄	Bariumsulfate-Turbidity	610	172
360	Sulfate PP	PP	5-100	mg/l SO ₄	Bariumsulfate-Turbidity ²	530	174
365	Sulfide	tablet	0.04-0.5	mg/l S	DPD/Catalyst ^{3,4}	660	176
370	Sulfite T	tablet	0.1-5	mg/l SO ₃	DTNB	430	178
390	Urea T	tablet + liquid	0.1-3	mg/l Urea	Indophenol/Urease	610	180
400	Zinc T	tablet	0.02 -1	mg/l Zn	Zincon ³	610	182

* = free, combined, total; PP = powder pack; T = tablet;

L = liquid; TT = tube test; LR = low range; MR = middle range; HR = high range;

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1.1 Methods

Literature

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

- 1) Unified German Procedures for the Analysis of Water and Wastewater
- 2) Standard Methods for the Examination of Water and Wastewater; 18th Edition, 1992
- 3) Photometric Analysis Procedures, Schwedt, Scientific Publishing Company Society, Stuttgart, 1989
- 4) Photometric Analysis, Lange / Vejdelek, 1980
- 5) Colorimetric Chemical Analytical Methods, 9th Edition, London

Notes for searching:

Active Oxygen	->	Oxygen, active
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
Silicon dioxide	->	Silica
total Alkalinity	->	Alkalinity, total
total Hardness	->	Hardness, total

Langelier Saturation -> Mode function 70
Index (Water Balance)

Important Notes for use of this manual - PLEASE READ:

1) The Method number for each test is indicated in the large circles at the beginning of each procedure. Here is an example:



- 2) The Symbol "Ø" signifies the OUTSIDE Diameter of the Sample Vial
- 3) Please note the appropriate reagent platform (tablet, powder, vial, etc.) for each test.
- 4) Be sure to observe the proper reagent reaction time indicated for each procedure for accurate results.

1.1 Methods

2

0

Acid demand to pH 4.3 with Tablet

0.1 – 4 mmol/l



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 Σ marks are aligned.
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 several times until the tablet is dissolved.
7. Place the vial in the sample chamber making sure that the Σ marks are aligned.
8. Press **TEST** key.

prepare Zero
press ZERO

Zero accepted
prepare Test
press TEST

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, be sure to test on exactly 10 ml of water sample .

1.1 Methods

3

0

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

5 – 200 mg/l CaCO_3



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 Σ marks are aligned.
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 several times until the tablet is dissolved.
7. Place the vial in the sample chamber making sure that the Σ 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 (K _{S4.3})	German °dH*	English °eH*	French °fH*
1 mg/l CaCO ₃	0.02	0.056	0.07	0.1

*Carbonate hardness (reference = Hydrogen carbonate-anions)

Example:

$$10 \text{ mg/l CaCO}_3 = 10 \text{ mg/l} \times 0.056 = 0.56 \text{ mg/l } ^\circ\text{dH}$$

$$10 \text{ mg/l CaCO}_3 = 10 \text{ mg/l} \times 0.02 = 0.2 \text{ mmol/l}$$

4. ▲ CaCO₃

°dH

°eH

°fH

▼ °aH

1.1 Methods

3

5

Alkalinity-p = p-value with Tablet

5 – 500 mg/l CaCO_3



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 Σ marks are aligned.
3. Press **ZERO** key.
4. Remove the vial from the sample chamber.
5. Add **one ALKA-P-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 Σ marks are aligned.
8. Press **TEST** key.

Zero accepted
prepare Test
press TEST

The result is shown in the display as Alkalinity-p.

1.1 Methods

Notes

1. The terms Alkalinity-p, p-Value and Alkalinity to pH 8.2 are identical.
2. For accurate test results exactly 10 ml of water sample must be taken for the test.
3. This method was developed from a volumetric procedure for the determination of Alkalinity-p. Due to undefined conditions, the deviations from the standardized method may be greater.
4. 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	----

▲ CaCO_3

°dH

°eH

°fH

▼ °aH

5. By determining Alkalinity-p and Alkalinity-m it is possible to classify the alkalinity as Hydroxide, Carbonate and Hydrogencarbonate.

The following differentiation is only valid if:

- a) no other alkalis are present and
- b) Hydroxide and Hydrogen are not present in the same water sample.

Case 1: Alkalinity-p = 0

Hydrogen carbonate = m

Carbonate = 0

Hydroxide = 0

Case 2: Alkalinity-p > 0 and Alkalinity-m > 2p

Hydrogen carbonate = m – 2p

Carbonate = 2p

Hydroxide = 0

Case 3: Alkalinity-p > 0 and Alkalinity-m < 2p

Hydrogen carbonate = 0

Carbonate = 2m – 2p

Hydroxide = 2p – m

1.1 Methods

4

0

Aluminum with Tablet

0.01 – 0.3 mg/l Al



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 Σ marks are aligned.
3. Press **ZERO** key.
4. Remove the vial from the sample chamber.
5. Add **one ALUMINUM 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 ALUMINUM 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 Σ marks are aligned.
9. Press **TEST** key.
Wait for a **reaction period of 5 minutes**.

Zero accepted
prepare Test
press TEST

Countdown
5:00

After the reaction period is finished the measurement starts automatically.

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

1.1 Methods

Notes:

1. Before using clean the vials and the measuring beaker with Hydrochloric acid (approx. 20%). Rinse then thoroughly with deionized 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 [mg/l F]	Displayed value: Aluminum [mg/l Al]					
	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	0.12	0.18	0.24	0.30	0.37
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 Aluminum determination is 0.15 mg/l Al and the Fluoride concentration is known to be 0.4 mg/l F. the true concentration of Aluminum is 0.17 mg/l Al.

4. ▲ Al
▼ Al₂O₃

1.1 Methods

5

0

Aluminum with Powder Pack

0.01 – 0.25 mg/l Al



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

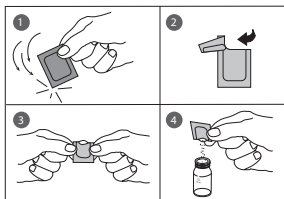
1. Fill **20 ml of the water sample** in a 100 ml beaker.
2. Add the contents of **one Aluminum ECR F20 Powder Pack** straight from the foil to the water sample.
3. Dissolve the powder using a clean stirring rod.
4. Press [**↵**] key.
Wait for a **reaction period of 30 seconds**.

Countdown 1

0:30

start: ↵

After the reaction period is finished proceed as follows:



5. Add the contents of **one Hexamine F20 Powder Pack** straight from the foil to the same water sample.
6. Dissolve the powder using a clean stirring rod.
7. Add **1 drop of 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.
11. Press [**↵**] key.
Wait for a **reaction period of 5 minutes**.

Countdown 2

5:00

start: ↵

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 Σ 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 Σ marks are aligned.

**Zero accepted
prepare Test
press TEST**

16. Press **TEST** key.

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

Notes:

1. Before using clean the vials and the measuring beaker with Hydrochloric acid (approx. 20%). Rinse then thoroughly with deionized 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 [mg/l F]	Displayed value: Aluminum [mg/l Al]					
	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	0.12	0.18	0.24	0.30	0.37
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 Aluminum determination is 0.15 mg/l Al and the Fluoride concentration is known to be 0.4 mg/l F, the true concentration of Aluminum is 0.17 mg/l Al.

4. \blacktriangle Al
 \blacktriangledown Al_2O_3

1.1 Methods

6

0

Ammonium with Tablet

0.02 – 1 mg/l N



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 Σ marks are aligned.
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 Σ marks are aligned.
9. Press **TEST** key.
Wait for a **reaction period of 10 minutes**.

Zero accepted
prepare Test
press TEST

Countdown
10:00

After the reaction period is finished the measurement starts automatically.

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

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 color 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 precipitations of salts.
Fill the test tube with the sample to the 10 ml mark and add one level spoonful of Conditioning Powder. Mix to dissolve, then continue as described in the test instructions.
5. Conversion:
$$\text{mg/l NH}_4 = \text{mg/l N} \times 1.29$$
$$\text{mg/l NH}_3 = \text{mg/l N} \times 1.22$$
6. ▲ N
NH₄
▼ NH₃

1.1 Methods

6

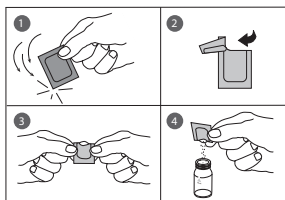
2

Ammonium with Powder Pack

0.01 – 0.8 mg/l N



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



Countdown 1

3:00

start: ⏴

1. Fill a clean vial (24 mm Ø) with **10 ml of deionized water** (this is the blank).
2. Fill the other clean vial (24 mm Ø) with **10 ml of the water sample** (this is the sample).
3. Add the contents of **one Ammonia Salicylate F10 Powder Pack** straight from the foil to each vial.
4. Close the vials with the caps and shake to mix the contents.
5. Press [⏴] key.
Wait for a **reaction period of 3 minutes**.

After the reaction period is finished proceed as follows:

6. Add the contents of **one Ammonia Cyanurate F10 Powder Pack** straight from the foil to each sample.
7. Close the vials tightly with the caps and shake to mix the contents.
8. Press [⏴] key.
Wait for a **reaction period of 15 minutes**.

After the reaction period is finished proceed as follows:

9. Place the vial (the blank) in the sample chamber making sure that the X marks are aligned.
10. Press **ZERO** key.
11. Remove the vial from the sample chamber.
12. Place the vial (the sample) in the sample chamber making sure that the X marks are aligned.
13. Press **TEST** key.

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

Countdown 2

15:00

start: ⏴

prepare Zero
press ZERO

Zero accepted
prepare Test
press TEST

1.1 Methods

Notes:

1. Extremely basic or acidic water samples should be adjusted with 0.5 mol/l (1 N) Sulfuric acid solution or 1 mol/l (1 N) Sodium hydroxide solution to pH 7.
2. Interferences:

Interfering substance	Interference levels and treatments
Calcium	greater than 1000 mg/l CaCO_3
Iron	Interferes at all levels. Correct as follows: a) determine the concentration of iron present in the sample by performing a total Iron test b) add the same iron concentration as determined to the deionized water (step 1). The interference will be blanked out successfully.
Magnesium	greater than 6000 mg/l CaCO_3
Nitrate	greater than 100 mg/l $\text{NO}_3\text{-N}$
Nitrite	greater than 12 mg/l $\text{NO}_2\text{-N}$
Phosphate	greater than 100 mg/l $\text{PO}_4\text{-P}$
Sulfate	greater than 300 mg/l SO_4
Sulfide	intensifies the color
Glycine, Hydrazine, Colour, Turbidity	Less common interferences such as Hydrazine and Glycine will cause intensified colors in the prepared sample. Turbidity and color will give erroneous high values. Samples with severe interferences require distillation.

3. ▲ N
 NH_4
 ▼ NH_3

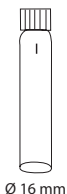
1.1 Methods

6

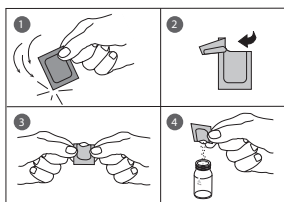
5

Ammonium LR with Vario Tube Test

0.02 – 2.5 mg/l N



Insert the adapter for 16 mm Ø vials.



1. Open one white capped reaction vial and add **2 ml deionized water** (this is the blank).
2. Open another white capped reaction vial and add **2 ml of the water sample** (this is the sample).
3. Add the contents of **one AMMONIA Salicylate F5 Powder Pack** straight from the foil into each vial.
4. Add the contents of **one AMMONIA Cyanurate F5 Powder Pack** straight from the foil into each vial.
5. Close the vials tightly with the caps and swirl several times to dissolve the powder.
6. Press **[↵]** key.
Wait for a **reaction period of 20 minutes**.

Countdown 1
20:00
start: ↵

After the reaction period is finished proceed as follows:

7. Place the vial (the blank) in the sample chamber making sure that the marks are **Δ** aligned.
8. Press **ZERO** key.
9. Remove the vial from the sample chamber.
10. Place the vial (the sample) in the sample chamber making sure that the marks are **Δ** aligned.
11. Press **TEST** key.

prepare Zero
press ZERO

Zero accepted
prepare Test
press TEST

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

1.1 Methods

Notes:

1. Strong alkaline or acidic water samples must be adjusted to approx. pH 7 before analysis (use 1 mol/l Hydrochloric acid resp. 1 mol/l Sodium hydroxide).
2. If chlorine is known to be present, add one drop of 0.1 mol/l Sodium thiosulfate for each 0.3 mg/l Cl_2 in a one liter (1000 mL) water sample.
3. Iron interferes with the test. The interferences will be eliminated as follows:
Determine the amount of total iron present in the water sample. To produce the blank add an iron standard solution with the same iron concentration to the vial (point 1) instead of deionized water
4. Conversion:
 $\text{mg/l NH}_4 = \text{mg/l N} \times 1.29$
 $\text{mg/l NH}_3 = \text{mg/l N} \times 1.22$
5. ▲ N
 NH_4
 ▼ NH_3

1.1 Methods

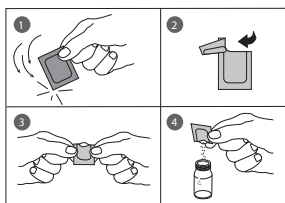


Ammonium HR with Vario Tube Test

1 – 50 mg/l N



Insert the adapter for 16 mm Ø vials.





1. Open one white capped reaction vial and add **0.1 ml deionized water** (this is the blank).
2. Open another white capped reaction vial and add **0.1 ml of the water sample** (this is the sample).
3. Add the contents of **one Vario AMMONIA Salicylate F5 Powder Pack** straight from the foil into each vial.
4. Add the contents of **one Vario AMMONIA Cyanurate F5 Powder Pack** straight from the foil into each vial.
5. Close the vials tightly with the caps and swirl several times to dissolve the powder.
6. Press [↵] key.
Wait for a **reaction period of 20 minutes**.

Countdown 1

20:00

start: ↵

After the reaction period is finished proceed as follows:

7. Place the vial (the blank) in the sample chamber making sure that the marks are  aligned.
8. Press **ZERO** key.
9. Remove the vial from the sample chamber.
10. Place the vial (the sample) in the sample chamber making sure that the marks are  aligned.
11. Press **TEST** key.

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

prepare Zero
press ZERO

Zero accepted
prepare Test
press TEST

1.1 Methods

Notes:

1. Strong alkaline or acidic water samples must be adjusted to approx. pH 7 before analysis (use 1 mol/l Hydrochloric acid resp. 1 mol/l Sodium hydroxide).
2. If chlorine is known to be present, add one drop of 0.1 mol/l Sodium thiosulfate for each 0.3 mg/l Cl_2 in a one litre water sample.
3. Iron interferes with the test. The interferences will be eliminated as follows:
Determine the amount of total iron present in the water sample. Add an iron standard solution with the same concentration to the vial (point 1) instead of deionized water to produce the blank.
4. Conversion:
 $\text{mg/l NH}_4 = \text{mg/l N} \times 1.29$
 $\text{mg/l NH}_3 = \text{mg/l N} \times 1.22$
5. ▲ N
 NH_4
 ▼ NH_3

1.1 Methods

8

5

Boron with Tablet

0.1 – 2 mg/l B



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 Σ marks are aligned.
3. Press **ZERO** key.
4. Remove the vial from the sample chamber.
5. Add **one BORON No. 1 tablet** straight from the foil to the water sample and crush the tablet using a clean stirring rod and dissolve the tablet.
6. Add **one BORON 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 Σ marks are aligned.

Zero accepted
prepare Test
press TEST

Countdown
20:00

9. Press **TEST** key.

Wait for a **reaction period of 20 minutes**.

After the reaction period is finished the measurement starts automatically.

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

1.1 Methods

Notes:

1. The tablets must added in the correct sequence.
2. The sample solution should have a pH value between 6 and 7.
3. Interferences are prevented by the presence of EDTA in the tablets.
4. The rate of color development depends on the temperature. The temperature of the sample must be $20^{\circ}\text{C} \pm 1^{\circ}\text{C}$.
5. ▲ B
▼ H_3BO_3

1.1 Methods

8



0

Bromine with Tablet

0.05 – 13 mg/l Br₂



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 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 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.
9. Press **TEST** key.

Zero accepted
prepare Test
press TEST

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 consumption.

Preparation: Put all applicable glassware into Sodium hypochlorite solution (0.1 g/l) for one hour, then rinse all glassware thoroughly with deionized water.

2. Preparing the sample:

When preparing the sample, the escape of Bromine gases, e.g. by pipetting or shaking, must be avoided. The analysis must take place immediately after taking the sample.

3. The DPD color development is carried out at a pH value of 6.3 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 of the measuring range:

Concentrations above 22 mg/l Bromine can produce results within the measuring range up to 0 mg/l. In this event, the water sample must be diluted with water free of Bromine. 10 ml of the diluted sample will be mixed with the reagent and the measurement repeated.

Oxidizing agents such as Chlorine, Ozone etc. interfere as they react like Bromine.

1.1 Methods

9



0

Chloride with Tablet

0.5 – 25 mg/l Cl



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 CHLORIDE T1 tablet** straight from the foil to the water sample, crush the tablet using a clean stirring rod and dissolve the tablet.
6. Add **one CHLORIDE T2 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 (Note 1).
8. Place the vial in the sample chamber making sure that the  marks are aligned.

Zero accepted
prepare Test
press TEST

Countdown
2:00

9. Press **TEST** key.

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

After the reaction period is finished the measurement starts automatically.

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

1.1 Methods

Notes:

1. Ensure that all particles of the tablet are dissolved – Chloride causes an extremely fine distributed turbidity with a milky appearance.
Heavy shaking leads to bigger sized particles which can cause false readings.
2. High concentrations of electrolytes and organic compounds have different effects on the precipitation reaction.
3. Ions which also form deposits with Silver nitrate in acidic media, such as Bromides, Iodides and Thiocyanates, interfere with the analysis.
4. Highly alkaline water should - if necessary - be neutralized using Nitric acid before analysis.

1.1 Methods

1 0 0

Chlorine with Tablet

0.01 – 6 mg/l Cl₂

1 0 1

Chlorine with Liquid Reagent

0.02 – 4 mg/l Cl₂

1 1 0

Chlorine with Powder Pack

0.02 – 2 mg/l Cl₂

Chlorine

>> 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 consumption.

Preparation: Put all applicable glassware into Sodium hypochlorite solution (0.1 g/l) for one hour, then rinse all glassware thoroughly with deionized water.

2. For individual testing of free and total Chlorine, the use of different sets of glassware is recommend (EN ISO 7393-2, 5.3)

3. Preparing the sample:

When preparing the sample, the escape of Chlorine gases, e.g. by pipetting or shaking, must be avoided. The analysis must take place immediately after taking the sample.

4. The DPD color development is carried out at a pH value of 6.3 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 of 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 produce results within the measuring range up to 0 mg/l. In this event, the water sample must be diluted with water free of Chlorine. 10 ml of the diluted sample will be mixed with the reagent and the measurement repeated.

6. Turbidity (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 event, the reagent tablet DPD No. 1 High Calcium should be used as an alternative. Even if the 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 exactly values, because the development of turbidity depends on nature and ingredients of the sample.*

7. If ??? is displayed at a differentiated test result see page 242.

Oxidizing agents such as Bromine, Ozone etc. interfere as they react like Chlorine.

1.1 Methods



Chlorine, differentiated determination with Tablet

0.01 – 6 mg/l Cl₂



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 Σ marks are aligned.
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 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 Σ 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.

1.1 Methods

13. Place the vial in the sample chamber making sure that the Σ 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 37.

1.1 Methods



Chlorine, free with Tablet

0.01 – 6 mg/l Cl_2



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 Σ marks are aligned.
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 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 Σ marks are aligned.
9. Press **TEST** key.

**Zero accepted
prepare Test
press TEST**

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

Notes:

See page 37.

1.1 Methods



Chlorine, total with Tablet

0.01 – 6 mg/l Cl₂



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 Σ marks are aligned.
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 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 Σ marks are aligned.

**Zero accepted
prepare Test
press TEST**

**Countdown
2:00**

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

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 37.

1.1 Methods



Chlorine, differentiated determination with Liquid Reagent

0.02 – 4 mg/l Cl_2



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 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 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.

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.

**Zero accepted
prepare T1
press TEST**

1.1 Methods

**T1 accepted
prepare T2
press TEST**

**Countdown
2:00**

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

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

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

After the reaction period is finished the measurement starts automatically.

The result is shown in the display in:

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

Notes:

1. After use replace the bottle caps securely noting the color coding.
2. **Store the reagent bottles in a cool, dry place ideally between 6°C and 10°C.**
3. Also see page 37.

1.1 Methods



Chlorine, free with Liquid Reagent

0.02 – 4 mg/l Cl_2



**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 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 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 37.

1.1 Methods

1 0 1

Chlorine, total with Liquid Reagent

0.02 – 4 mg/l Cl_2



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 Σ marks are aligned.

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 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 Σ marks are aligned.

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

Zero accepted
prepare Test
press TEST

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



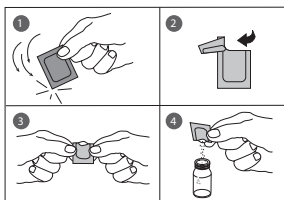
Chlorine, differentiated determination with Powder Pack

0.02 – 2 mg/l Cl_2



Ø 24 mm

**prepare Zero
press ZERO**



**Zero accepted
prepare T1
press TEST**

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 Σ marks are aligned.
3. Press **ZERO** key.
4. Remove the vial from the sample chamber.
5. Add the contents of **one Chlorine FREE-DPD/ F10 Powder Pack** straight from the foil to 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 Σ marks are aligned.
8. Press **TEST** key.
9. Remove the vial from the sample chamber, empty the vial, rinse vial and cap several times and then fill the vial with **10 ml of the water sample**.
10. Add the contents of **one Chlorine TOTAL-DPD / F10 Powder Pack** straight from the foil to 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

**T1 accepted
prepare T2
press TEST**

**Countdown
3:00**

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

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

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

After the reaction period is finished the measurement starts automatically.

The result is shown in the display in:

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

Notes:

See page 37.

1.1 Methods



Chlorine, free with Powder Pack

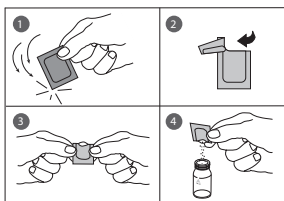
0.02 – 2 mg/l Cl_2



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 Σ marks are aligned.
3. Press **ZERO** key.

**prepare Zero
press ZERO**

4. Remove the vial from the sample chamber.



5. Add the contents of **one Chlorine FREE-DPD / F10 Powder Pack** straight from the foil to 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 Σ 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 37.

1.1 Methods

1 1 0

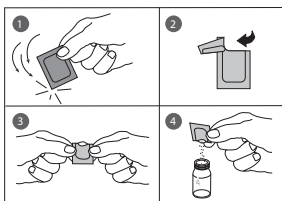
Chlorine, total with Powder Pack

0.02 – 2 mg/l Cl_2



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 Σ marks are aligned.
3. Press **ZERO** key.
4. Remove the vial from the sample chamber.



5. Add the contents of **one Chlorine TOTAL-DPD / F10 Powder Pack** straight from the foil to 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 Σ marks are aligned.

Zero accepted
prepare Test
press TEST

Countdown
3:00

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

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 37.

1.1 Methods



Chlorine dioxide with Tablet

0.05 – 11 mg/l ClO_2

Chlorine dioxide
>> **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 consumption.

Preparation: Put all applicable glassware into Sodium hypochlorite solution (0.1 g/l) for one hour, then rinse all glassware thoroughly with deionized water.

2. Preparing the sample:

When preparing the sample, the escape of Chlorine dioxide gases, e.g. by pipetting or shaking, must be avoided. The analysis must take place immediately after taking the sample.

3. The DPD color development is carried out at a pH value of 6.3 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 of the measuring range:

Concentrations above 19 mg/l Chlorine dioxide can produce results within the measuring range up to 0 mg/l. In this event, the water sample must be diluted with water free of Chlorine dioxide. 10 ml of the diluted sample will be mixed with the reagent and the measurement repeated.

5. If ??? is displayed at a differentiated test result see page 242.

Oxidizing agents such as Chlorine, Ozone etc. interfere as they react like Chlorine dioxide.

1.1 Methods



Chlorine dioxide in the presence of Chlorine with Tablet

0.05 – 11 mg/l ClO_2



**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 Σ marks are aligned.
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 the 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 Σ marks are aligned.
12. Press **TEST** key.

**Zero accepted
prepare T1
press TEST**

1.1 Methods

**T1 accepted
prepare T2
press TEST**

13. Remove the vial from the sample chamber, empty the vial, rinse vial and cap several times. Fill with **a few drops of the water sample**.
14. Add **one DPD No. 1 tablet** straight from the foil and crush the tablet using a clean stirring rod.
15. Add 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 Σ marks are aligned.

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 Σ marks are aligned.

23. Press **TEST** key.

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

After the reaction period is finished the measurement starts automatically.

The result is shown in the display in:

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

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

**T2 accepted
prepare T3
press TEST**

**Countdown
2:00**

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

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

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

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).

$$\text{mg/l } \text{ClO}_2 = \text{mg/l } \text{ClO}_2 [\text{Cl}] \times 0.38$$



(Chlorine dioxide displayed as Chlorine units $\text{ClO}_2 [\text{Cl}]$ has its origin out of the swimming poolwater treatment according to DIN 19643.)

2. The total Chlorine result given includes the contribution by 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 51.

1.1 Methods

1

2

0

Chlorine dioxide in absence of Chlorine with Tablet

0.05 – 11 mg/l ClO_2



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 Σ marks are aligned.
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 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 Σ marks are aligned.

**Zero accepted
prepare Test
press TEST**

9. Press **TEST** key.

The result is shown in the display

as Chlorine dioxide in mg/l Chlorine,
or

as Chlorine dioxide in mg/l ClO_2 .

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

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

Notes:

See page 51.

1.1 Methods

1

0

5



Chlorine HR (KI) with Tablet

5 – 200 mg/l Cl₂



Ø 16 mm

Insert the adapter for 16 mm Ø vials.

1. Fill a clean vial (16 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 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.
8. Place the vial in the sample chamber making sure that the marks are  aligned.
9. Press **TEST** key.

prepare Zero
press ZERO

Zero accepted
prepare Test
press TEST

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

1.1 Methods

Notes:

1. Oxidizing agents interfere as they react like Chlorine.

1.1 Methods

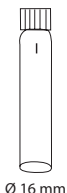
1

3



0

COD LR with Vario Tube Test

0 – 150 mg/l O₂



Insert the adapter for 16 mm Ø vials.

1. Open one white capped reaction vial and add **2 ml deionized water** (this is the blank (Note 1)).
2. Open another white capped reaction vial and add **2 ml of the water sample** (this is the sample).
3. Close the vials with the cap tightly. Invert the vial gently several times to mix the contents.
(CAUTION: The vial will become hot during mixing!)
4. Heat the vials for **120 minutes** in the preheated reactor at a temperature of **150°C**.
5. **(CAUTION: The vials are hot!)**
Remove the tubes from the heating block and allow them to cool to 60°C or less. Mix the contents by carefully inverting each tube several times while still warm. Then allow the tubes to cool to ambient temperature before measuring. (Note 2).
6. Place the vial (the blank (Note 3, 4)) in the sample chamber making sure that the marks are  aligned.
7. Press **ZERO** key.
8. Remove the vial from the sample chamber.
9. Place the vial (the sample (Note 3, 4)) in the sample chamber making sure that the marks are  aligned.
10. Press **TEST** key.

prepare Zero
press ZERO

Zero accepted
prepare Test
press TEST

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

1.1 Methods

Notes:

1. Run samples and blanks with the same batch of vials. The blank is stable when stored in the dark and can be used for further measurements with vials of the same batch.
2. Do not place the hot vials in the sample chamber. Cool the vials to room temperature for final measurements.
3. Suspended solids in the vial lead to incorrect measurements. For this reason it is important to place the vials carefully in the sample chamber. The precipitate at the bottom of the sample should be not suspended.
4. Clean the outside of the vials with a towel to remove finger prints or other marks.
5. Samples can be measured when the Chloride contents does not exceed 1000 mg/l.
6. Be aware that low readings can result if the water contains compounds that cannot be oxidized completely, as compared to the reference method.

1.1 Methods

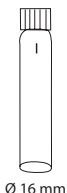
1

3



1

COD MR with Vario Tube Test

0 – 1500 mg/l O₂



Insert the adapter for 16 mm Ø vials.

1. Open one white capped reaction vial and add **2 ml deionized water** (this is the blank (Note 1)).
2. Open another white capped reaction vial and add **2 ml of the water sample** (this is the sample).
3. Close the vials with the cap tightly. Invert the vial gently several times to mix the contents.
(CAUTION: The vial will become hot during mixing!)
4. Heat the vials for **120 minutes** in the preheated reactor at a temperature of **150°C**.
5. **(CAUTION: The vials are hot!)**
Remove the tubes from the heating block and allow them to cool to 60°C or less. Mix the contents by carefully inverting each tube several times while still warm. Then allow the tubes to cool to ambient temperature before measuring. (Note 2).
6. Place the vial (the blank (Note 3, 4)) in the sample chamber making sure that the marks are  aligned.
7. Press **ZERO** key.
8. Remove the vial from the sample chamber.
9. Place the vial (the sample (Note 3, 4)) in the sample chamber making sure that the marks are  aligned.
10. Press **TEST** key.

**prepare Zero
press ZERO**

**Zero accepted
prepare Test
press TEST**

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

1.1 Methods

Notes:

1. Run samples and blanks with the same batch of vials. The blank is stable when stored in the dark and can be used for further measurements with vials of the same batch.
2. Do not place the hot vials in the sample chamber. Cool the vials to room temperature for final measurements.
3. Suspended solids in the vial lead to incorrect measurements. For this reason it is important to place the vials carefully in the sample chamber. The precipitate at the bottom of the sample should be not suspended.
4. Clean the outside of the vials with a towel to remove finger prints or other marks.
5. Samples can be measured when the Chloride contents does not exceed 1000 mg/l.
6. Be aware that low readings can result if the water contains compounds that cannot be oxidized completely, as compared to the reference method.
7. For samples under 100 mg/l COD it is recommended to repeat the test with the tube test for COD LR.

1.1 Methods

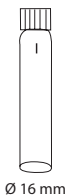
1

3



2

COD HR with Vario Tube Test

0 – 15 g/l O₂ (\pm 0 – 15,000 mg/l O₂)



Insert the adapter for 16 mm Ø vials.

1. Open one white capped reaction vial and add **0.2 ml deionized water** (this is the blank (Note 1)).
2. Open another white capped reaction vial and add **0.2 ml of the water sample** (this is the sample).
3. Close the vials with the cap tightly. Invert the vial gently several times to mix the contents.
(CAUTION: The vial will become hot during mixing!)
4. Heat the vials for **120 minutes** in the preheated reactor at a temperature of **150°C**.
5. **(CAUTION: The vials are hot!)**
Remove the tubes from the heating block and allow them to cool to 60°C or less. Mix the contents by carefully inverting each tube several times while still warm. Then allow the tubes to cool to ambient temperature before measuring. (Note 2).
6. Place the vial (the blank (Note 3, 4)) in the sample chamber making sure that the marks are  aligned.
7. Press **ZERO** key.
8. Remove the vial from the sample chamber.
9. Place the vial (the sample (Note 3, 4)) in the sample chamber making sure that the marks are  aligned.
10. Press **TEST** key.

prepare Zero
press ZERO

Zero accepted
prepare Test
press TEST

The result is shown in the display in **g/l COD**.

1.1 Methods

Notes:

1. Run samples and blanks with the same batch of vials. The blank is stable when stored in the dark and can be used for further measurements with vials of the same batch.
2. Do not place the hot vials in the sample chamber. Cool the vials to room temperature for final measurements.
3. Suspended solids in the vial lead to incorrect measurements. For this reason it is important to place the vials carefully in the sample chamber. The precipitate at the bottom of the sample should be not suspended.
4. Clean the outside of the vials with a towel to remove finger prints or other marks.
5. Samples can be measured when the Chloride contents does not exceed 1000 mg/l.
6. Be aware that low readings can result if the water contains compounds that cannot be oxidized completely, as compared to the reference method.
7. For samples under 1 g/l COD it is recommended to repeat the test with the test kit for COD MR or for samples under 0,1 g/l COD with the tube test COD LR.

1.1 Methods



Copper with Tablet

0.05 – 5 mg/l Cu

Copper

>> **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 differentiated test result see page 242.

1.1 Methods



Copper, differentiated determination with Tablet

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 Σ 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 Σ marks are aligned.
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 Σ marks are aligned.
13. Press **TEST** key.

Zero accepted
prepare T1
press TEST

T1 accepted
prepare T2
press TEST

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

The result is shown in the display in:
mg/l free Copper
mg/l combined Copper
mg/l total Copper

1.1 Methods





Copper, free with Tablet

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 Test
press TEST**

8. Press **TEST** key.

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

1.1 Methods



Copper, total with Tablet

0.05 – 5 mg/l Cu



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 **X** marks are aligned.
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 **X** marks are aligned.
8. Press **TEST** key.

**prepare Zero
press ZERO**

**Zero accepted
prepare Test
press TEST**

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

1.1 Methods

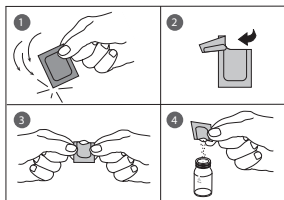


Copper, free (Note 1) with Powder Pack

0.05 – 5 mg/l Cu



prepare Zero
press ZERO



Zero accepted
prepare Test
press TEST

Countdown
2:00

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 Σ marks are aligned.
3. Press **ZERO** key.
4. Remove the vial from the sample chamber.
5. Add the contents of **one Cu 1 F10 Powder Pack** straight from the foil to 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 Σ marks are aligned.
8. Press **TEST** key.

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

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, a 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).
3. Accuracy is not affected by undissolved powder.
4. Interferences:

Cyanide, CN^-	Cyanide prevents full color 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.
Silver, Ag^+	If a turbidity remains and turns black, silver interferences 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.

1.1 Methods

1

5

7

Cyanide with Reagent Test

0.01 – 0.5 mg/l CN



**prepare Zero
press ZERO**

1. Fill a clean vial (24 mm Ø) with **2 ml of the water sample and 8 ml of deionized water**, close tightly with the cap.
2. Place the vial in the sample chamber making sure that the Σ marks are aligned.

3. Press **ZERO** key.

4. Remove the vial from the sample chamber.

5. Add **two level spoons No. 4 (grey) of Cyanide-11** into the prepared water sample, replace the cap tightly and invert the vial several times to mix the contents.

6. **Add two level spoons No. 4 (grey) of Cyanide-12**, replace the cap tightly and invert the vial several times to mix the contents.

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

3 drops of Cyanide-13

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

9. Place the vial in the sample chamber making sure that the Σ marks are aligned.

10. Press **TEST** key.

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 in mg/l Cyanide.

**Zero accepted
prepare Test
press TEST**

**Countdown
10:00**

1.1 Methods

Notes:

1. Only free Cyanide and Cyanides that can be destroyed by Chlorine are determined by this test.
2. In the present of Thiocyanate, heavy metal complexes, colorants or aromatic amines, the cyanide must be separated out by distillation before analysis is performed.

3. Store the reagents in closed containers at a temperature of + 15°C to + 25°C.

1.1 Methods



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 deionized water (Note 1)**, close tightly with the cap.
2. Place the vial in the sample chamber making sure that the Σ marks are aligned.
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 Σ marks are aligned.
8. Press **TEST** key.

prepare Zero
press ZERO

Zero accepted
prepare Test
press TEST

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

1.1 Methods

Notes:

1. Use deionized water or tap water free of Cyanuric acid.
2. If Cyanuric acid is present a cloudy solution will result.
3. Dissolve the tablet completely (therefore swirl the vial approx. 1 minute).
Undissolved particles of the tablet can cause too high results.

1.1 Methods



DEHA (N,N-Diethylhydroxylamine) with Tablet and Liquid Reagent

20 – 500 µg/l DEHA / 0.02 – 0.5 mg/l DEHA



**prepare Zero
press ZERO**

1. Fill a clean vial (24 mm Ø) with **10 ml of the water sample**, close tightly with the cap (Note 2).

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

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 (0.25ml) of DEHA solution

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

7. Add **one DEHA tablet** straight from the foil to the same water sample 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. Place the vial in the sample chamber making sure that the Σ marks are aligned.

10. Press **TEST** key.

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 DEHA.

**Zero accepted
prepare Test
press TEST**

**Countdown
10:00**

1.1 Methods

Notes:

1. Application: Testing of residual corrosion inhibitors (Oxygen scavengers) in boiler feed water or condensate.
2. Before using clean the vials with Hydrochloric acid (approx. 20%). Rinse thoroughly with deionized water.
3. Keep the sample dark during color development time. UV-light (sunlight) causes high measurement results.
4. Ideal temperature for full color development is $20^{\circ}\text{C} \pm 2^{\circ}\text{C}$.
5. Interferences:
 - Iron (II) interferes at all concentrations:
Repeat the test procedure but without adding the DEHA solution. If the displayed result is above 20 $\mu\text{g/l}$ subtract this value from the DEHA test result.
 - Substances which reduce Iron (III) or complex iron may interfere.
 - Substances which may interfere when present in concentrations at:

Borate (as $\text{Na}_2\text{B}_4\text{O}_7$)	500 mg/l
Cobalt	0.025 mg/l
Copper	8.0 mg/l
Hardness (as CaCO_3)	1000 mg/l
Lignosulfonates	0.05 mg/l
Manganese	0.8 mg/l
Molybdenum	80 mg/l
Nickel	0.8 mg/l
Phosphate	10 mg/l
Phosphonates	10 mg/l
Sulfate	1000 mg/l
Zinc	50 mg/l

6. There is an option to change the unit from mg/l to $\mu\text{g/l}$.
The unit mg/l is rounded, e.g.: 25 $\mu\text{g/l}$ = 0.025 mg/l → display 0.03 mg/l.

▲ mg/l

▼ $\mu\text{g/l}$

1.1 Methods

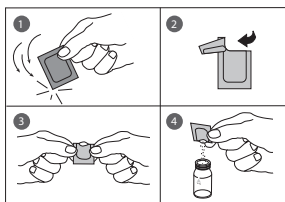


DEHA (N,N-Diethylhydroxylamine) with Powder Pack and Liquid Reagent

20 – 500 µg/l DEHA / 0.02 – 0.5 mg/l DEHA



Use two clean vials (24 mm Ø) and mark one as blank for zeroing (Note 2).



1. Fill a clean vial with **10 ml deionized water** (this is the blank).
2. Fill the second clean vial with **10 ml of the water sample** (this is the sample).
3. Add the contents of **one OXYSCAV 1 Rgt Powder Pack** straight from the foil into each vial.
4. Close the vials tightly with the caps and swirl several times to mix the contents.
5. Add **0.20 ml DEHA 2 Rgt Solution** to each vial (Note 4).
6. Close the vials tightly with the caps and swirl several times to mix the contents.

Countdown 1

10:00

start: ↓

7. Press **[←]]** key.
Wait for a reaction **period of 10 minutes** (Note 5).
After the reaction period is finished proceed as follows:
8. Place the vial (the blank) in the sample chamber making sure that the **X** marks are aligned.

prepare Zero
press ZERO

9. Press **ZERO** key.
10. Remove the vial from the sample chamber.
11. Place the vial (the sample) in the sample chamber making sure that the **X** marks are aligned.

Zero accepted
prepare Test
press TEST

12. Press **TEST** key.
The result is shown in the display as DEHA.

1.1 Methods

Notes:

1. Application: Testing of residual corrosion inhibitors (Oxygen scavengers) in boiler feed water or condensate.
2. Before using clean the vials with Hydrochloric acid (approx. 20%). Rinse thoroughly with deionized water.
3. Ideally temperature for full color development is $25^{\circ}\text{C} \pm 3^{\circ}\text{C}$.
4. Volume should always be metered by using suitable pipette (class A).
5. Keep blank and sample dark during color development time. UV-light (sunlight) causes too high measurement results.
6. Interferences:
 - Iron (II) interferes at all concentrations:
Repeat the test procedure but without adding the DEHA Rgt 2 solution. If the displayed result is above $20\text{ }\mu\text{g/l}$ subtract this value from the DEHA test result.
 - Substances which reduce Iron (III) interfere. Substances which complex iron strongly may interfere also.
 - Substances who may interfere when present in concentrations at:

Borate (as $\text{Na}_2\text{B}_4\text{O}_7$)	500 mg/l
Cobalt	0.025 mg/l
Copper	8.0 mg/l
Hardness (as CaCO_3)	1000 mg/l
Lignosulfonates	0.05 mg/l
Manganese	0.8 mg/l
Molybdenum	80 mg/l
Nickel	0.8 mg/l
Phosphate	10 mg/l
Phosphonates	10 mg/l
Sulfate	1000 mg/l
Zinc	50 mg/l

7. There is an option to change the unit from mg/l to $\mu\text{g/l}$.
The unit mg/l is rounded, e.g.: $25\text{ }\mu\text{g/l} = 0.025\text{ mg/l} \rightarrow \text{display } 0.03\text{ mg/l}$.

▲ mg/l

▼ $\mu\text{g/l}$

1.1 Methods



Fluoride with Liquid Reagent

0.05 – 2 mg/l F



Ø 24 mm

Regard notes!

1. Fill a clean vial (24 mm Ø) with **exactly 10 ml of water sample** (Note 4), close tightly with the cap.
2. Place the vial in the sample chamber making sure that the Σ marks are aligned.
3. Press **ZERO** key.
4. Remove the vial from the sample chamber.
5. Add **exactly 2 ml SPADNS reagent solution** (Note 4) to the water sample.
Caution: Vial is filled up to the top! (Note 8)
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 Σ marks are aligned.

Press **TEST** key.

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

prepare Zero
press ZERO

Zero accepted
prepare Test
press TEST

1.1 Methods

Notes:

1. The same batch of SPADNS reagent solution must be used for adjustment and test.
The adjustment process needs to be performed for each new batch of SPADNS reagent solution (see Standard Methods 20th, 1998, APHA, AWWA, WEF 4500 F D., S. 4-82).
The procedure is described in chapter 2.4.5 "Calibration" Mode 40" on page 215.
2. During adjustment and test the same vial should be used for zeroing and test, as different vials may exhibit minor tolerances.
3. The calibration solution and the water samples to be tested should have the same temperature ($\pm 1^{\circ}\text{C}$).
4. As the test result is highly dependent on exact sample and reagent volumes, the sample and reagent volumes should always be metered by using a 10 ml resp. 2 ml volumetric pipette (class A).
5. The accuracy of the test methods decreases above a level of 1.2 mg/l Fluoride. Although the results are sufficiently accurate for most applications, even more exact results can be achieved by 1:1 dilution of the sample prior to use and subsequent multiplication of the result by 2.
6. SPADNS reagent solution contains Arsenite.
Chlorine concentrations up to 5 mg/l do not interfere.
7. Seawater and wastewater samples must be distilled.
8. It is convenient to use larger volume vials for this test.

1.1 Methods



Hardness, Calcium with tablet reagent

50 – 900 mg/l CaCO_3



Ø 24 mm

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

prepare Zero
press ZERO

Countdown
2:00

5. Press **ZERO** key.

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

After the reaction period is finished the measurement starts automatically.

6. Remove the vial from the sample chamber.
7. Add **2 ml of the water sample** to the prepared vial.
Caution: Vial is filled up to the top! (Note 4)
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 Σ 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. 1 mol/l Sodium hydroxide).
2. The tolerance of the method is increased with higher concentrations. When diluting samples, this should be taken 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 standardized method may be greater.
4. It is convenient to use larger volume vials for this test.
5. ▲ CaCO_3
°dH
°eH
°fH
▼ °aH

1.1 Methods



Hardness, total with tablet reagent

2 – 50 mg/l CaCO_3



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 Σ marks are aligned.
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 several times until the tablet is dissolved.
7. Place the vial in the sample chamber making sure that the Σ marks are aligned.

**Zero accepted
prepare Test
press TEST**

**Countdown
5:00**

8. Press **TEST** key.

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

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. 1 mol/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

1.1 Methods



Hardness, total HR with Tablet

20 – 500 mg/l CaCO_3



Ø 24 mm

**prepare Zero
press ZERO**

1. Fill a clean vial (24 mm Ø) with **1 ml of the water sample** and **9 ml of deionized water**, close tightly with the cap.
2. Place the vial in the sample chamber making sure that the Σ marks are aligned.

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 several times until the tablet is dissolved.

7. Place the vial in the sample chamber making sure that the Σ 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. 1 mol/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

1.1 Methods

2 0 5

Hydrazine with powder reagent

0.05 – 0.5 mg/l N_2H_4 / 50 – 500 $\mu\text{g/l}$ N_2H_4



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

prepare Zero
press ZERO

4. Remove the vial from the sample chamber.
5. Add **1 g HYDRAZINE test powder** (Note 3) to the water sample.
6. Close the vial tightly with the cap and swirl several times to mix the contents.

Countdown
10:00
start: ↴

7. Press [\leftarrow] key.
Wait for a **reaction period of 10 minutes**.
After the reaction period is finished proceed as follows:
8. The slight turbidity that occurs when the reagent is added must be removed by filtration (Note 4).
9. Place the vial in the sample chamber making sure that the Σ marks are aligned.

Zero accepted
prepare Test
press TEST

10. Press **TEST** key.
The result is shown in the display as Hydrazine.

1.1 Methods

Notes:

1. If the water sample is cloudy, it should be filtered it before performing the zero calibration.
2. The temperature of the water sample should not exceed 21°C.
3. Using the Hydrazine spoon: 1 g is equivalent to one level spoon.
4. Qualitative folded filter papers for medium precipitates are recommended.
5. In order to check whether the reagent has aged (if it has been stored for a lengthy period), perform the test as described above using tap water. If the result is above the detection limit of 0.05 mg/l, you should use new reagents, as it could result in major result deviations.
6. There is an option to change the unit from mg/l to µg/l.

The unit mg/l is rounded, e.g.: 25 µg/l = 0.025 mg/l → display 0.03 mg/l.

▲ mg/l

▼ µg/l

1.1 Methods



Hydrazine with Liquid Reagent

0.01 – 0.6 mg/l N_2H_4 / 5 – 600 $\mu\text{g/l}$ N_2H_4



Ø 24 mm

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

1. Fill a clean vial with **10 ml deionized water** (this is the blank).
2. Add **1 ml Hydra 2 Rgt Solution** into the vial (Note 3).
3. Close the vial tightly with the cap and swirl several times to mix the contents.
4. Place the vial (the blank) in the sample chamber making sure that the Σ marks are aligned.
5. Press **ZERO** key.
6. Remove the vial from the sample chamber.
7. Fill the second clean vial with **10 ml of the water sample** (this is the sample).
8. Add **1 ml Hydra 2 Rgt Solution** into the vial.
9. Close the vial tightly with the cap and swirl several times to mix the contents.
10. Place the vial (the blank) in the sample chamber making sure that the Σ marks are aligned.
11. Press **TEST** key.
Wait for a **reaction period of 12 minutes**.

**prepare Zero
press ZERO**

**Zero accepted
prepare Test
press TEST**

**Countdown
12:00**

After the reaction period is finished the measurement starts automatically.

The result is shown in the display as Hydrazine.

1.1 Methods

Notes:

1. Samples cannot be preserved and must be analyzed immediately.
2. Sample temperature should be $21^{\circ}\text{C} \pm 4^{\circ}\text{C}$.
3. Caused by the reagent itself the blank may develop a faint yellow color.
4. Interferences:
 - Ammonium causes no interferences up to 10 mg/l.
At a concentration of 20 mg/l it is possible that the test result increase up to 20%.
 - Morpholine does not interfere up to 10 mg/l.
 - Highly colored or turbid samples:
Mix 1 part deionized water with 1 part household bleach. Add 1 drop of this mixture into 25 ml water sample and mix. Use 10 ml prepared sample in place of deionized water in point 1.
Note: at point 7 use the unprepared water sample.
Principle: Hydrazine is oxidized by the household bleach. The interference by color will be eliminated by zeroing.
5. There is an option to change the unit from mg/L to $\mu\text{g/L}$.
The unit mg/L is rounded, e.g.: $25 \mu\text{g/L} = 0.025 \text{ mg/L} \rightarrow \text{display } 0.03 \text{ mg/L}$.

▲ mg/l
▼ $\mu\text{g/l}$

1.1 Methods



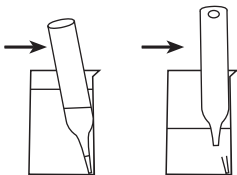
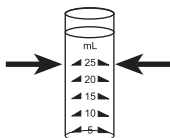
Hydrazine with Vacu-vials® K-5003 (see Notes)

0.01 – 0.7 mg/l N_2H_4 / 10 – 700 $\mu\text{g/l}$ N_2H_4

Insert the adapter for 13 mm Ø vials.

1. Place the blank in the sample chamber. The blank is part of the test kit.

prepare Zero
press ZERO



2. Press **ZERO** key.
3. Remove the blank from the sample chamber.
4. Fill the sample container to the 25 ml mark with the water sample.
5. Place one Vacu-vial® in the sample container. Snap the tip by pressing the vial against the side of the sample container. The Vacu-vial® breaks at the neck and the vial fills automatically. A small volume of inert gas remains in the Vacu-vial®.
6. Mix the contents of the Vacu-vial® by inverting it several times, allowing the bubble to move from one end to the other. Dry the outside of the vial.
7. Place the Vacu-vial® in the sample chamber.

Zero accepted
prepare Test
press TEST

Countdown
10:00

8. Press **TEST** key.

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 Hydrazine.

1.1 Methods

Notes:

1. This method is adapted from CHEMetrics.
2. Read the original test instruction and the MSDS (delivered with the test) before performing the test. MSDS is also available at www.chemetrics.com.
3. Vacu-vials® is a registered trade mark of the company CHEMetrics, Inc. / Calverton, VA. U.S.A.
4. There is an option to change the unit from mg/l to µg/l.
The unit mg/l is rounded, e.g.: 25 µg/l = 0.025 mg/l → display 0.03 mg/l.

▲ mg/l

▼ µg/l

1.1 Methods



Hydrogen peroxide with tablet reagent

0.03 – 3 mg/l H₂O₂



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 Σ marks are aligned.
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 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 Σ marks are aligned.

prepare Zero
press ZERO

Zero accepted
prepare Test
press TEST

Countdown
2:00

9. Press **TEST** key.

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

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 consumption.

Preparation: Put all applicable glassware into Sodium hypochlorite solution (0.1 g/l) for one hour, then rinse all glassware thoroughly with deionized water.

2. Preparing the sample:

When preparing the sample, the escape of Hydrogen peroxide gases, e.g. by pipetting or shaking, must be avoided. The analysis must take place immediately after taking the sample.

3. The DPD color development is carried out at a pH value of 6.3 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 of the measuring range:

Concentrations above 5 mg/l Hydrogen peroxide can produce results within the measuring range up to 10 mg/l. In this event, the water sample must be diluted with water free of Hydrogen peroxide. 10 ml of the diluted sample will be mixed with the reagent and the measurement repeated.

Oxidizing agents such as Chlorine, Ozone etc. interfere as they react like Hydrogen peroxide.

1.1 Methods



Iodine with Tablet

0.05 – 3.6 mg/l l



**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 Σ marks are aligned.
3. Press **ZERO** key.
4. Remove the vial from the sample chamber, **empty the vial leaving a view drops in.**
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 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 Σ 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. Oxidizing reagents, such as Chlorine, Bromine, etc. interfere as they react like Iodine.

1.1 Methods

2 2 0

Iron with Tablet

0.02 – 1 mg/l Fe

*Determination of total dissolved Iron Fe^{2+} and Fe^{3+}

2 2 2

Iron with Powder Pack

0.02 – 3 mg/l Fe

*Determination of all soluble iron and most insoluble forms of iron.

2 2 3

Iron, total with Powder Pack

0.02 – 1.8 mg/l Fe

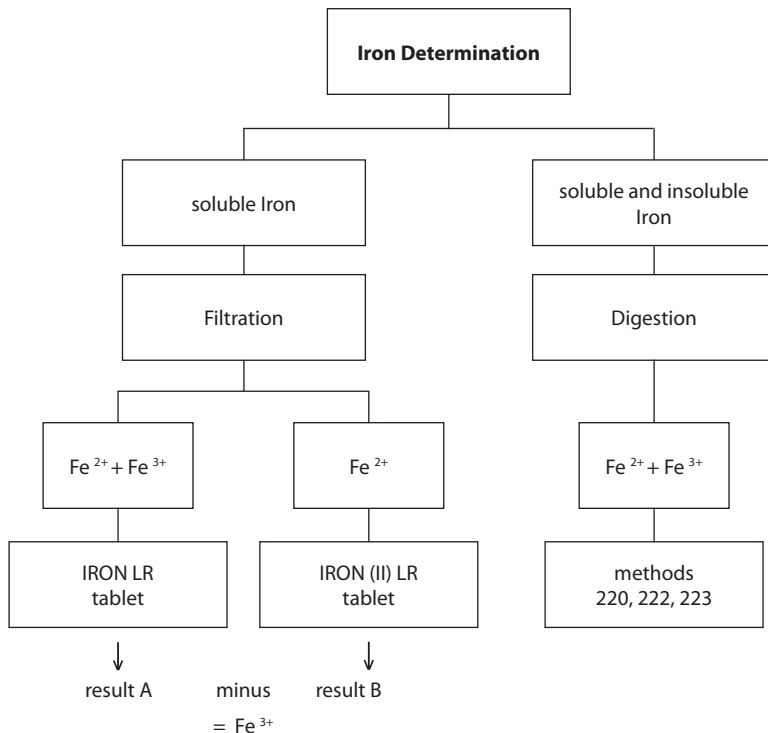
*Determination of all soluble iron and most insoluble forms of iron; most insoluble iron oxides are recovered by the reagent.

*This information refers to analysis of the water sample without digestion.

Further information is found in the method notes.

1.1 Methods

Notes:



Digestion procedure for the determination of total soluble and insoluble 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 at the selected test method.
2. Water which has been treated with organic compounds like corrosion inhibitors must be oxidized 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



Iron (Note 1) with Tablet

0.02 – 1 mg/l Fe



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 Σ marks are aligned.
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 Σ marks are aligned.

Zero accepted
prepare Test
press TEST

Countdown
5:00

8. Press **TEST** key.
Wait for a **reaction period of 5 minutes**.

After the reaction period is finished the measurement starts automatically.

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

1.1 Methods

Notes:

1. This method determines the total dissolved Iron as Fe^{2+} and Fe^{3+} .
2. The IRON (II) LR tablet is used for differentiation – as described above – instead of the IRON LR tablet.
3. For the determination of total dissolved and undissolved iron, a digestion is required. An example is described on page 97.

1.1 Methods




Iron (Note 1) with Powder Pack

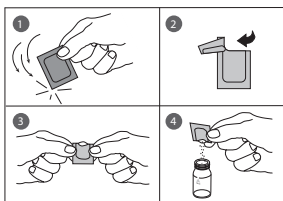
0.02 – 3 mg/l Fe




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 the contents of **one Ferro F10 Powder Pack** straight from the foil to the water sample.
6. Close the vial tightly with the cap and swirl several times to mix the contents (Note 4).
7. Place the vial in the sample chamber making sure that the  marks are aligned.

Zero accepted
prepare Test
press TEST

Countdown
3:00

8. Press **TEST** key.
Wait for a **reaction period of 3 minutes (Note 5)**.

After the reaction period is finished the measurement starts automatically.

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

1.1 Methods

Notes:

1. The reagent reacts with all soluble iron and most insoluble forms of iron in the water sample.
2. Iron oxide requires a prior digestion, use mild, vigorous or Digesdahl digestion (e.g. for digestion with acid see page 97).
3. Very strong alkaline or acidic water samples must be adjusted to a pH-Value between 3 and 5 before analysis.
4. Accuracy is not affected by undissolved powder.
5. Water samples containing visible rust should be allowed to react at least five minutes.

1.1 Methods

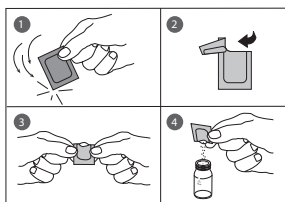


Iron, total (TPTZ, Note 1) with Powder Pack

0.02 – 1.8 mg/l Fe



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



1. Fill a clean vial with **10 ml deionized water** (this is the blank).
2. Fill the second clean vial with **10 ml of the water sample** (this is the sample).
3. Add the contents of **one IRON TPTZ F10 Powder Pack** straight from the foil into each vial.
4. Close the vials tightly with the caps and swirl several times to mix the contents.

Countdown
3:00
start: ↵

5. Press [↵] key.
Wait for a reaction **period of 3 minutes**.

After the reaction period is finished proceed as follows:

6. Place the vial (the blank) in the sample chamber making sure that the X marks are aligned.
7. Press **ZERO** key.
8. Remove the vial from the sample chamber.
9. Place the vial (the sample) in the sample chamber making sure that the X marks are aligned.
10. Press **TEST** key.

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

prepare Zero
press ZERO

Zero accepted
prepare Test
press TEST

1.1 Methods

Notes:

1. For determination of total Iron digestion is required.
TPTZ reagent recovers most insoluble iron oxides without digestion.
2. Rinse all glassware with 1:1 Hydrochloric acid solution first and then rinse with deionized water to remove iron deposits that can cause slightly high results.
3. Strong alkaline or acidic water samples must be adjusted between pH 3 and pH 8 before the reagent is added (use 0.5 mol/l Sulfuric acid resp. 1 mol/l Sodium hydroxide).
4. Interferences:

When interferences occurred, the color development was inhibited or a precipitate was formed.

The values below refer to a standard with an iron concentration of 0.5 mg/l.

The following substances do not interfere when present up to the levels given:

Substance	no interference to
Cadmium	4.0 mg/l
Chromium ⁽³⁺⁾	0.25 mg/l
Chromium ⁽⁶⁺⁾	1.2 mg/l
Cobalt	0.05 mg/l
Copper	0.6 mg/l
Cyanide	2.8 mg/l
Manganese	50 mg/l
Mercury	0.4 mg/l
Molybdenum	4.0 mg/l
Nickel	1.0 mg/l
Nitrite Ion	0.8 mg/l

1.1 Methods

2

4

0

Manganese with Tablet

0.2 – 4 mg/l Mn



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 Σ marks are aligned.

3. Press **ZERO** key.

4. Remove the vial from the sample chamber.

5. Add **one MANGANESE LR 1 tablet** straight from the foil to the water sample and crush the tablet using a clean stirring rod and dissolve the tablet.

6. Add **one MANGANESE LR 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 Σ are aligned.

9. Press **TEST** key.

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

After the reaction period is finished the measurement starts automatically.

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

Zero accepted
prepare Test
press TEST

Countdown
5:00

1.1 Methods

Note:

1. ▲ Mn
MnO₄
▼ KMnO₄

1.1 Methods



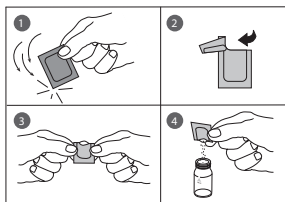
Manganese LR with Powder Pack

0.01 – 0.7 mg/l Mn



Ø 24 mm

Use two clean vials (24 mm Ø) and mark one as blank for zeroing (Note 1).



1. Fill a clean vial with **10 ml of deionized water** (this is the blank).
2. Fill the second clean vial with **10 ml of the water sample** (this is the sample).

3. Add the contents of **one Ascorbic Acid Powder Pack** straight from the foil into each vial. (Note 2)

4. Close the vials tightly with the caps and swirl several times to mix the contents.

5. Fill each vial with drops of the same size by holding the bottle vertically and squeeze slowly (Note 3):
15 drops of Alkaline Cyanide reagent solution

6. Close the vials tightly with the caps and swirl several times to mix the contents.

7. Fill each vial with drops of the same size by holding the bottle vertically and squeeze slowly:
21 drops of PAN Indicator solution

8. Close the vials tightly with the caps and swirl several times to mix the contents.

Countdown 1
2:00
start: ⏸

9. Press **[⏸]** key.
Wait for a **reaction period of 2 minutes** (Note 4).

After the reaction period is finished proceed as follows:

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

prepare Zero
press ZERO

10. Press **ZERO** key.
11. Remove the vial from the sample chamber.

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

Zero accepted
prepare Test
press TEST

13. Press **TEST** key.

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

1.1 Methods

Notes:

1. Rinse all glassware with 1:1 Nitric acid solution first and then rinse with deionized water.
2. Water samples that contain more than 300 mg/l CaCO_3 hardness: After adding the Ascorbic Acid powder pack add additionally 10 drops of Rochelle Salt Solution.
3. After addition of the reagent solution "Alkaline-Cyanide" a cloudy or turbid solution may form in some water samples. The turbidity should disappear after point 7.
4. Water samples containing more than 5 mg/l iron should be allowed to react at least 10 minutes.
5. Conversion:
 $\text{mg/l MnO}_4 = \text{mg/l Mn} \times 2.17$
6. ▲ Mn
 MnO_4
 ▼ KMnO_4

1.1 Methods



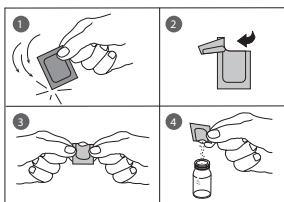
Manganese HR with Powder Pack

0.1 – 18 mg/l Mn



**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 Σ marks are aligned.
3. Press **ZERO** key.
4. Remove the vial from the sample chamber.



5. Add the contents of **one Citrate Powder Pack** straight from the foil to the water sample.
6. Close the vial tightly with the cap and swirl several times to mix the contents.
7. Add the contents of **one Sodium Periodate Powder Pack** straight from the foil to the same water sample.
8. Close the vial tightly with the cap and swirl several times to mix the contents.
9. Place the vial in the sample chamber making sure that the Σ marks are aligned

**Zero accepted
prepare Test
press TEST**

**Countdown
2:00**

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

After the reaction period is finished the measurement starts automatically.

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

1.1 Methods

Notes:

1. This test is applicable for the determination of soluble Manganese in water and wastewater.
2. Highly buffered or water sample with extreme pH-values may exceed the buffering capacity of the reagents and requires sample pre-treatment.
If samples were acidified for storing, adjust the pH between 4 and 5 with 5 mol/l (5 N) Sodium hydroxide before test. Do not exceed pH 5, as manganese may precipitate.
3. Interferences:

Interfering substance	Interference level
Calcium	greater than 700 mg/l
Chloride	greater than 70 000 mg/l
Iron	greater than 5 mg/l
Magnesium	greater than 100 000 mg/l

4. ▲ Mn
MnO₄
▼ KMnO₄

1.1 Methods



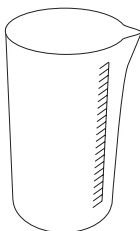
Molybdate with Tablet

1 – 50 mg/l MoO_4 / 0.6 – 30 mg/l Mo



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 Σ marks are aligned.
3. Press **ZERO** key.
4. Remove the vial from the sample chamber and **empty the vial**.
5. Fill **20 ml of the water sample** in a 100 ml beaker.
6. Add **one MOLYBDATE HR No. 1 tablet** straight from the foil to the water sample and crush the tablet using a clean stirring rod.
7. Add **one MOLYBDATE HR No. 2 tablet** straight from the foil to the same water sample and crush the tablet using a clean stirring rod.
8. Dissolve the tablets using a clean stirring rod.
9. Rinse out the vial with the prepared water sample and then fill to the 10 ml mark.
10. Close the vial tightly with the cap.
11. Place the vial in the sample chamber making sure that the Σ marks are aligned.
12. Press **TEST** key.

**Zero accepted
prepare Test
press TEST**

The result is shown in the display in mg/l Molybdate / Molybdenum.

1.1 Methods

Notes:

1. The tablets must be added in the correct sequence.
2. Under test conditions (pH 3.8 – 3.9) iron does not interfere nor do other metals at levels likely to be found in industrial water systems.
3. Conversions:
 $\text{mg/l Mo} = \text{mg/l MoO}_4 \times 0.6$
 $\text{mg/l Na}_2\text{MoO}_6 = \text{mg/l MoO}_4 \times 1.3$
4. ▲ MoO_4
Mo
▼ Na_2MoO_4

1.1 Methods



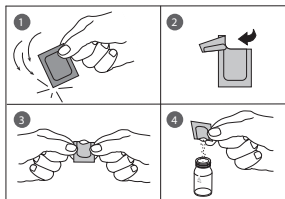
Molybdate / Molybdenum HR with Powder Pack

0.5 – 66 mg/l MoO_4 / 0.3 – 40 mg/l Mo



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 Σ marks are aligned.
3. Press **ZERO** key.
4. Remove the vial from the sample chamber.
5. Add the contents of **one Molybdenum HR 1 F10 Powder Pack** straight from the foil to the water sample.
6. Close the vial tightly with the cap and swirl several times to mix the contents.
7. Add the contents of **one Molybdenum HR 2 F10 Powder Pack** straight from the foil to the same water sample.
8. Close the vial tightly with the cap and swirl several times to mix the contents.
9. Add the contents of **one Molybdenum HR 3 F10 Powder Pack** straight from the foil to the same water sample.
10. Close the vial tightly with the cap and swirl several times to mix the contents.
11. Place the vial in the sample chamber making sure that the Σ marks are aligned.
12. Press **TEST** key.
Wait for a **reaction period of 5 minutes**.

Zero accepted
prepare Test
press TEST

Countdown
5:00

After the reaction period is finished the measurement starts automatically.

The result is shown in the display in mg/l Molybdate / Molybdenum.

1.1 Methods

Notes:

1. Filter turbid water samples using filter paper and funnel before analysis.
2. Highly buffered water samples or extreme pH values should be adjusted to a pH of nearly 7 with 1 mol/l Nitric acid or 1 mol/l Sodium hydroxide.
3. Concentration from 10 mg/l Copper will result in artificially high test values if the described reaction time of 5 minutes is increased. Thus, it is very important to perform the test procedure continuously.
4. Substances below may interfere when present in concentrations above these limits:

Aluminium	50 mg/l
Chromium	1000 mg/l
Iron	50 mg/l
Nickel	50 mg/l
Nitrite	all levels

5. ▲ MoO_4
Mo
▼ Na_2MoO_4

1.1 Methods

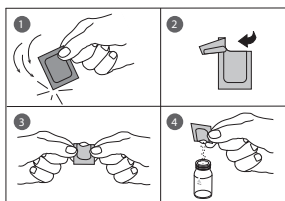


Nitrate with Tube Test

1 – 30 mg/l N



Ø 16 mm



Countdown
5:00
start: ↩

Insert the adapter for 16 mm Ø vials.

1. Open one white capped vial (Reagent A) and add **1 ml deionized water** (this is the blank).
2. Open another white capped vial (Reagent A) and add **1 ml of the water sample** (this is the sample).
3. Add the contents of **one Nitrate Chromotropic Powder Pack straight** from the foil into each vial.
4. Close the vials tightly with the caps and invert gently several times (10 x) to mix the contents (Note 1).
5. Press **[↩]** key.
Wait for a **reaction period of 5 minutes**.
6. After the reaction period is finished proceed as follows:
7. Place the vial (the blank) in the sample chamber making sure that the marks are **Δ** aligned.
8. Press **ZERO** key.
9. Remove the vial from the sample chamber.
10. Place the vial (the sample) in the sample chamber making sure that the marks are **Δ** aligned.
11. Press **TEST** key.

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

prepare Zero
press ZERO

Zero accepted
prepare Test
press TEST

1.1 Methods

Notes:

1. Some solids may not dissolve.

2. Conversion:

$$\text{mg/l NO}_3 = \text{mg/l N} \times 4.43$$

3. ▲ N

▼ NO₃

1.1 Methods





Nitrite with Tablet

0.01 – 0.5 mg/l N



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 NITRITE 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**

**Countdown
10:00**

8. Press **TEST** key.
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 in mg/l Nitrite.

1.1 Methods

Notes:

1. The following ions can produce interferences since under the reaction conditions they cause precipitation:

Antimony (III), Iron (III), Lead, Mercury (I), Silver, Chloroplatinate, Metavanadate and Bismuth.

Copper (II)-ions may cause lower test results as they accelerate the decomposition of the Diazonium salt.

It is improbable that these interfering ions will occur in such high concentrations that they cause significant reading errors.

2. Conversion:

$$\text{mg/l NO}_2 = \text{mg/l N} \times 3.29$$

3. ▲ N

▼ NO₂

1.1 Methods



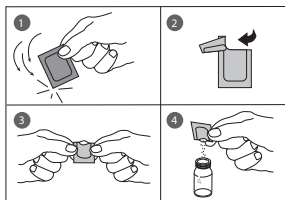
Nitrite LR with Powder Pack

0.01 – 0.3 mg/l N



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 Σ marks are aligned.
3. Press **ZERO** key.

prepare Zero
press ZERO



4. Remove the vial from the sample chamber.
5. Add the contents of **one Nitrite 3 Powder Pack** straight from the foil to 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 Σ marks are aligned.

Zero accepted
prepare Test
press TEST

Countdown
20:00

8. Press **TEST** key.
Wait for a **reaction period of 20 minutes**.

After the reaction period is finished the measurement starts automatically.

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

1.1 Methods

Notes:

1. Interferences:

- Strong oxidizing and reducing substances interfere.
- Presence of cupric and ferrous ions can cause low results.
- Antimonous, Auric, Bismuth, Chloroplatinate, Ferric, Lead, Mercurous, Metavanadate, Silver ions can also interfere by causing precipitation.
- In samples with very high concentrations of Nitrate ($> 100 \text{ mg/L N}$) a small amount of Nitrite will be found. Such high levels of Nitrate appear to undergo a slight amount of reduction to Nitrite, either spontaneously or during the reaction time of the test.

2. ▲ N

▼ NO₂

1.1 Methods

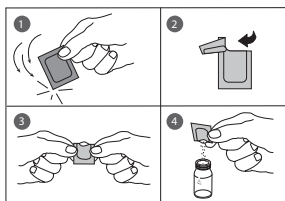
2 8 0

Nitrogen, total LR with Tube Test

0.5 – 25 mg/l N



Ø 16 mm



Insert the adapter for 16 mm Ø vials.

1. **Open two TN Hydroxide LR digestion vials** and add the contents of **one Vario TN Persulfate Rgt. Powder Pack** (Note 2, 3).
2. Add **2 ml deionized water** to the prepared vial (this is the blank, Note 4, 5).
3. Add **2 ml of the water sample** to the other prepared vial (this is the sample).
4. Close the vials with the caps and shake to mix the contents (at least 30 seconds, Note 6).
5. Heat the vials for **30 minutes** in the preheated reactor at a temperature of **100°C** (Note 7).
6. After 30 minutes remove the vials from the reactor. **(CAUTION: The vials are hot!)**
Allow the vials to cool to room temperature.
7. Open the cooled digestion vials and add the contents of **one TN Reagent A Powder Pack** to each vial (Note 2).
8. Close the vials with the caps and shake to mix the contents (at least 15 seconds).
9. Press [↵] key.
Wait for a **reaction period of 3 minutes**.
After the reaction period is finished proceed as follows:
10. Open the digestion vials and add the contents of **one TN Reagent B Powder Pack** to each vial (Note 2).
11. Close the vials with the caps and shake to mix the contents (at least 15 seconds, Note 8).
12. Press [↵] key.
Wait for a **reaction period of 2 minutes**.
After the reaction period is finished proceed as follows:
13. Open **two TN Acid LR/HR (Reagent C) vials** and add **2 ml of the digested, treated blank** to one vial (this is the blank).
14. Add **2 ml of the digested, treated water sample** to the other TN Acid LR/HR vial (this is the sample).
15. Close the vials with the caps and swirl the vials gently several times to mix the contents (10 x, Note 9).
(CAUTION: Vials warm up).

Countdown
3:00
start: ↵


Countdown
2:00
start: ↵

1.1 Methods

**prepare Zero
press ZERO**

**Countdown
5:00**

**Zero accepted
prepare Test
press TEST**


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

17. Press **ZERO** key.

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

After the reaction period is finished the measurement starts automatically.



18. Remove the vial from the sample chamber.

19. Place the vial (the sample, Note 10) in the sample chamber making sure that the marks  are aligned.

20. Press **TEST** key.

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

Notes:

1. Use appropriate safety precautions and good lab technique during the procedure for most accurate results.
2. Use a funnel to add the reagent.
3. Wipe off any Persulfate reagent that may get on the lid or the tube threads.
4. Volumes for samples and blank should always be metered by using 2 ml volumetric pipettes (class A).
5. One blank is sufficient for each set of samples.
6. The reagent may not dissolve completely.
7. It is very important to remove the vials from the reactor after exactly 30 minutes.
8. The reagent will not completely dissolve.
9. Hold the vial in a vertical position with the cap pointing up. Turn the vial upside-down. Wait for all of the solution to flow down to the cap. Return the vial to the upright position. Wait for all the solution to flow to the bottom of the vial. This process is one inversion; 10 inversions = approx. 30 seconds.
10. After zero calibration with the blank it is possible to measure several samples.
11. Great quantities of nitrogen free, organic compounds which are included in some water samples may reduce the effectiveness of the digestion by reacting with the Persulfate reagent. Samples which are well known to contain great quantities of organic compounds must be diluted and digestion and measurement must be repeated for checking the effectiveness of the digestion.
12. Application: for water, wastewater and seawater
13. Interferences:
Interfering substances that resulted in a concentration change of 10%:
Bromide more than 60 mg/l and Chloride more than 1000 mg/l produce positive interferences.
TN = Total Nitrogen
14.  N
 NH₄
 NH₃

1.1 Methods

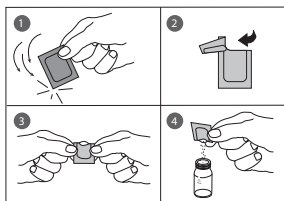


Nitrogen, total HR with Tube Test

5 – 150 mg/l N



Insert the adapter for 16 mm Ø vials.



Countdown

3:00

start: ⏴

Countdown

2:00

start: ⏴


1. **Open two TN Hydroxide HR digestion vials** and add the contents of **one TN Persulfate Rgt. Powder Pack** (Note 2, 3).
2. Add **0.5 ml deionized water** to the prepared vial (this is the blank, Note 4, 5).
3. Add **0.5 ml of the water sample** to the other prepared vial (this is the sample).
4. Close the vials with the caps and shake to mix the contents (at least 30 seconds, Note 6).
5. Heat the vials for **30 minutes** in a preheated reactor at a temperature of **100°C** (Note 7).
6. After 30 Minutes remove the vials from the reactor. **(CAUTION: The vials are hot!)**
Allow the vials to cool to room temperature.
7. Open the cooled digestion vials and add the contents of **one TN Reagent A Powder Pack** to each vial (Note 2).
8. Close the vials with the caps and shake to mix the contents (at least 15 seconds).
9. Press [⏴] key.
Wait for a **reaction period of 3 minutes**.
After the reaction period is finished proceed as follows:
10. Open the digestion vials and add the contents of **one TN Reagent B Powder Pack** to each vial (Note 2).
11. Close the vials with the caps and shake to mix the contents (at least 15 seconds, Note 8).
12. Press [⏴] key.
Wait for a **reaction period of 2 minutes**.
After the reaction period is finished proceed as follows:
13. Open **two TN Acid LR/HR (Reagent C) vials** and add **2 ml of the digested, treated blank** to one vial (this is the blank).
14. Add **2 ml of the digested, treated water sample** to the other TN Acid LR/HR vial (this is the sample).
15. Close the vials with the caps and swirl the vials gently several times to mix the contents (10 x, Note 9).
(CAUTION: Vials warm up).

1.1 Methods

**prepare Zero
press ZERO**

**Countdown
5:00**


**Zero accepted
prepare Test
press TEST**

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

17. Press **ZERO** key.
Wait for a **reaction period of 5 minutes**.



After the reaction period is finished the measurement starts automatically.

18. Remove the vial from the sample chamber.

19. Place the vial (the sample, Note 10) in the sample chamber making sure that the  marks are aligned.

20. Press **TEST** key.
The result is shown in the display in mg/l Nitrogen.

Notes:

1. Appropriate safety precautions and a good lab technique should be used during the whole procedure.
2. Use a funnel to add the reagent.
3. Wipe off any Persulfate reagent that may get on the lid or the tube threads.
4. Volumes for samples and blank should always be metered by using suitable pipettes (class A).
5. One blank is sufficient for each set of samples.
6. The reagent may not dissolve completely.
7. It is very important to remove the vials from the reactor after exactly 30 minutes.
8. The reagent will not completely dissolve.
9. Hold the vial in a vertical position with the cap pointing up. Turn the vial upside-down. Wait for all of the solution to flow down to the cap. Return the vial to the upright position. Wait for all the solution to flow to the bottom of the vial. This process is one inversion; 10 inversions = approx. 30 seconds.
10. After zero calibration with the blank it is possible to measure several samples.
11. Great quantities of nitrogen free, organic compounds which are included in some water samples may reduce the effectiveness of the digestion by reacting with the Persulfate reagent. Samples which are well known to contain great quantities of organic compounds must be diluted and digestion and measurement must be repeated for checking the effectiveness of the digestion.
12. Application: for water, wastewater and seawater
13. Interferences:
Interfering substances that resulted in a concentration change of 10%:
Bromide more than 60 mg/l and Chloride more than 1000 mg/l produce positive interferences.
TN = Total Nitrogen
14.  N
NH₄
 NH₃

1.1 Methods





Oxygen, active* with Tablet

0.1 – 10 mg/l O₂



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 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

Countdown
2:00

8. Press **TEST** key.

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

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 disinfectant (based on "Oxygen") in Swimming Pool Treatment.**

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

1.1 Methods

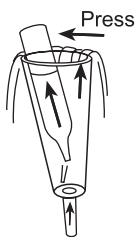


Oxygen, dissolved with Vacu-vials® K-7553 (see Notes)

10 – 800 µg/l O₂

Insert the adapter for 13 mm Ø round vials.

prepare Zero
press ZERO



1. Place the blank in the sample chamber. The blank is part of the test kit.

2. Press **ZERO** key.

3. Remove the blank from the sample chamber.

4. Water should flow through the special sample container for several minutes to remove any air bubbles sticking at the surface.

The water must flow from the bottom to the top.

5. When the sample container is bubble-free press one Vacu-vial® into the lower edge of the sample container. The Vacu-vial® breaks at the neck and the vial fills automatically.

A small volume of inert gas remains in the Vacu-vial®.

6. Remove the Vacu-vial® point downwards from the sample container immediately.

As the contents of the vial has a higher density than water, it is important to remove the vial from the sample container within 5 seconds to prevent any loss of reagent.

7. The Vacu-vial® is closed with one finger (covered with a glove) to prevent entry of air. Invert the vial several times. Dry the outside of the vial.

8. Place the Vacu-vial® in the sample chamber.

Zero accepted
prepare Test
press TEST

9. Press **TEST** key.

The result is shown in the display in µg/l Oxygen.

1.1 Methods

Notes:

1. This method is adapted from CHEMetrics.
2. Read the original test instruction and the MSDS (delivered with the test) before performing the test. MSDS also at www.chemetrics.com available.
3. Vacu-vials® is a registered trade mark of the company CHEMetrics, Inc. / Calverton, VA, U.S.A.

1.1 Methods

3 0 0

Ozone with Tablet

0.02 – 1 mg/l O₃

Ozon

>>

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 method 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 consumption.

Preparation: Put all applicable glassware into Sodium hypochlorite solution (0.1 g/l) for one hour, then rinse all glassware thoroughly with deionized water.

2. Preparing the sample:

When preparing the sample, the escape of Ozone gases, e.g. by pipetting or shaking, must be avoided. The analysis must take place immediately after taking the sample.

3. The DPD color development is carried out at a pH value of 6.3 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 (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 exactly values, because the development of turbidity depends on nature and ingredients of the sample.*

5. Exceeding of the measuring range:

Concentrations above 5 mg/l Ozone can produce results within the measuring range up to 0 mg/l. In this event, the water sample must be diluted with water free of Ozone. 10 ml of the diluted sample will be mixed with the reagent and the measurement repeated.

6. If ??? is displayed at the differentiated test result see page 242.

Oxidizing agents such as Bromine, Chlorine etc. interfere as they react like Ozone.

1.1 Methods



Ozone, in the presence of Chlorine with Tablet

0.02 – 1 mg/l O₃



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 Σ marks are aligned.
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 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 Σ marks are aligned.
9. Press **TEST** key.
Wait for a **reaction period of 2 minutes.**

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 the 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.

Zero accepted
prepare T1
press TEST

Countdown
2:00

1.1 Methods

12. **Fill a second clean vial with 10 ml of the 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 \times marks are aligned.

**T1 accepted
prepare T2
press TEST**

**Countdown
2:00**

*** ** mg/l O₃
* ** mg/l total Cl**

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

After the reaction period is finished the measurement starts automatically.

The result is shown in the display in:

mg/l Ozone
mg/l total Chlorine

Notes:

See page 129.

1.1 Methods



Ozone, in absence of Chlorine with Tablet

0.02 – 1 mg/l O₃



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 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 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

Countdown
2:00

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

After the reaction period is finished the measurement starts automatically.

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

Notes:

See page 129.

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1.1 Methods

7

0

PHMB (Biguanide) with Tablet

2 – 60 mg/l PHMB



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 Σ marks are aligned.
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 Σ marks are aligned.
8. Press **TEST** key.

Zero accepted
prepare Test
press TEST

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

1.1 Methods

Notes:

1. Clean vials with the brush after analysis directly.
2. Over time, it is possible that the vials and stirring rods may turn blue in color. In this case, clean vials and stirring rods with a laboratory detergent (see chapter 1.2.2 Cleaning of vials and accessories for analysis). Rinse vials and caps thoroughly with tap water followed by deionized water.
3. The test result is influenced by Hardness and Total Alkalinity.

The calibration of this method was done using water of the following concentration:

Ca-Hardness: 200 mg/l CaCO_3

Total Alkalinity: 120 mg/l CaCO_3

1.1 Methods

3 2 0

Phosphate, ortho LR with Tablet

0.05 – 4 mg/l PO_4

Determination of ortho-Phosphate ions

3 2 1

Phosphate, ortho HR with Tablet

1 – 80 mg/l PO_4

Determination of ortho-Phosphate ions

3 2 3

Phosphate, ortho with Powder Pack

0.06 – 2.5 mg/l PO_4

Determination of ortho-Phosphate ions

3 2 4

Phosphate, ortho with Tube Test

0.06 – 5 mg/l PO_4

Determination of ortho-Phosphate ions

3 2 7

Phosphate 1, ortho with Vacu-vials®

5 – 40 mg/l PO_4

Determination of ortho-Phosphate ions

3 2 8

Phosphate 2, ortho with Vacu-vials®

0.05 – 5 mg/l PO_4

Determination of ortho-Phosphate ions

3 2 5

Phosphate, acid hydrolyzable with Tube Test

0.02 – 1.6 mg/l P

Determination of ortho-Phosphate ions + condensed,
inorganic Phosphates

3 2 6

Phosphate, total with Tube Test

0.02 – 1.1 mg/l P

Determination of ortho-Phosphate ions + condensed,
inorganic Phosphates + organically combined Phosphates

1.1 Methods

General:

Ortho-Phosphate ions react with the reagent to a intense blue color (methods **320, 323, 324, 325** and **326**).

Phosphate in organic and condensed inorganic forms (meta-, pyro- and polyphosphates) must be converted to ortho-Phosphate ions before analysis.

Pretreatment of the sample with acid and heat provides the conditions for hydrolysis of the condensed inorganic forms. Organically combined phosphates are converted to ortho-Phosphate ions by heating with acid and persulfate.

The amount of organically combined phosphates can be calculated:

mg/l Phosphate, organic = mg/l Phosphate, total – mg/l Phosphate, acid hydrolyzable

In methods **321** and **327** the ortho-Phosphat ions react with the Vanadate-molybdate-reagent under acid conditions to a yellow colored product.

Notes - only for tube tests and tests with powder packs:

323, 324, 325, 326

1. Application: for water, wastewater and seawater.
2. Highly buffered samples or samples with extreme pH Values should be adjusted between pH 2 and pH 10 before analysis (with 1 mol/l Hydrochloric acid or 1 mol/l Sodium hydroxide).
3. Interferences:
Large amounts of turbidity may cause inconsistent results.

Interfering substance

Aluminium

Arsenate

Chromium

Copper

Iron

Nickel

Silica (Silicium dioxide)

Silicate

Sulfide

Zinc

Interference level:

greater than 200 mg/l

at any level

greater than 100 mg/l

greater than 10 mg/l

greater than 100 mg/l

greater than 300 mg/l

greater than 50 mg/l

greater than 10 mg/l

at any level

greater than 80 mg/l

Phosphate, ortho \triangleq Phosphorus, reactive

1.1 Methods





Phosphate, ortho LR with Tablet

0.05 – 4 mg/l PO₄



Ø 24 mm

**prepare Zero
press ZERO**

1. Fill a clean vial (24 mm Ø) with **10 ml of the water sample**, close the cap tightly.
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 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 several times until the tablet is dissolved.
8. Place the vial in the sample chamber making sure that the marks  are aligned.
9. Press **TEST** key.
Wait for a **reaction period of 10 minutes**.

**Zero accepted
prepare Test
press TEST**

**Countdown
10:00**

After the reaction period is finished the measurement starts automatically.

The result is shown in the display in mg/l ortho-Phosphate.

1.1 Methods

Notes:

1. Only ortho-Phosphate ions 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 color.
Silicates do not interfere (masked by Citric acid in the tablets).
5. see also page 137
6. Conversion:
 $\text{mg/l P} = \text{mg/l PO}_4 \times 0.33$
 $\text{mg/l P}_2\text{O}_5 = \text{mg/l PO}_4 \times 0.75$
7. ▲ PO_4
P
▼ P_2O_5

1.1 Methods



Phosphate HR, ortho with Tablet

1 – 80 mg/l PO₄



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 Σ marks are aligned.
3. Press **ZERO** key.
4. Remove the vial from the sample chamber.
5. Add **one PHOSPHATE HR P1 tablet** straight from the foil to the water sample and crush the tablet using a clean stirring rod.
6. Add **one PHOSPHATE HR P2 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 Σ marks are aligned.

Zero accepted
prepare Test
press TEST

Countdown
10:00

9. Press **TEST** key.

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 in mg/l ortho-Phosphate.

1.1 Methods

Notes:

1. For samples under 5 mg/l PO_4 it is best to use method 320 "Phosphate LR, ortho with Tablet".
2. Only ortho-Phosphate ions react.
3. see also page 137
4. Conversions:
 $\text{mg/l P} = \text{mg/l PO}_4 \times 0.33$
 $\text{mg/l P}_2\text{O}_5 = \text{mg/l PO}_4 \times 0.75$
5. ▲ PO_4
P
▼ P_2O_5

1.1 Methods



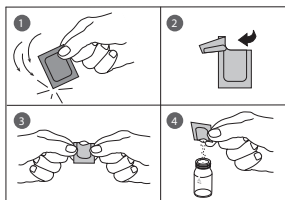
Phosphate, ortho with Powder Pack

0.06 – 2.5 mg/l PO₄



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 X marks are aligned.
3. Press **ZERO** key.

**prepare Zero
press ZERO**



4. Remove the vial from the sample chamber.
5. Add the contents of **Phosphate Rgt. F10 Powder Pack** straight from the foil to the water sample.
6. Close the vial tightly with the cap and swirl several times to mix the contents (approx. 10-15 sec., Note 1).
7. Place the vial in the sample chamber making sure that the X marks are aligned.

**Zero accepted
prepare Test
press TEST**

**Countdown
2:00**

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

After the reaction period is finished the measurement starts automatically.

The result is shown in the display in mg/l ortho-Phosphate.

1.1 Methods

Notes:

1. The reagent does not dissolve completely.
2. See also page 137
3. Conversions:
 $\text{mg/l P} = \text{mg/l PO}_4 \times 0.33$
 $\text{mg/l P}_2\text{O}_5 = \text{mg/l PO}_4 \times 0.75$
4. $\blacktriangle \text{PO}_4$
P
 $\blacktriangledown \text{P}_2\text{O}_5$

1.1 Methods



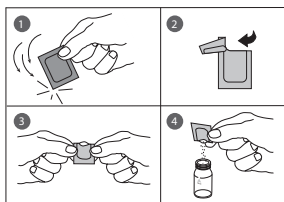
Phosphate, ortho with Tube Test

0.06 – 5 mg/l PO₄



Ø 16 mm



**prepare Zero
press ZERO**



**Zero accepted
prepare Test
press TEST**

**Countdown
2:00**

Insert the adapter for 16 mm Ø vials.

1. Open the white cap of one **tube PO₄-P Dilution** and add **5 ml of the water sample**.
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 the contents of **one Phosphate Rgt. F10 Powder Pack** straight from the foil to the water sample (Note 1).
6. Close the vial tightly with the cap and swirl several times to mix the contents (approx. 10-15 sec., Note 2).
7. Place the vial in the sample chamber making sure that the  marks are aligned.
8. Press **TEST** key.

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

After the reaction period is finished the measurement starts automatically.

The result is shown in the display in mg/l ortho-Phosphate.

1.1 Methods

Notes:

1. Use a funnel to add the reagent.
2. The reagent does not dissolve completely.
3. See also page 137
4. Conversions:
 $\text{mg/l P} = \text{mg/l PO}_4 \times 0.33$
 $\text{mg/l P}_2\text{O}_5 = \text{mg/l PO}_4 \times 0.75$
5. ▲ PO_4
P
▼ P_2O_5

1.1 Methods



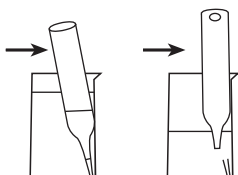
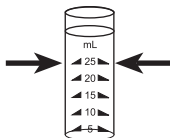
Phosphate 1, ortho with Vacu-vials® K-8503 (see Notes)

5 – 40 mg/l PO₄

Insert the adapter for 13 mm Ø vials.

1. Place the blank in the sample chamber. The blank is part of the test kit.

**prepare Zero
press ZERO**



2. Press **ZERO** key.
3. Remove the blank from the sample chamber.
4. Fill the sample container to the 25 ml mark with the water sample.
5. Place one Vacu-vial® in the sample container. Snap the tip by pressing the vial against the side of the sample container.

The Vacu-vial® breaks at the neck and the vial fills automatically.

A small volume of inert gas remains in the Vacu-vial®.

6. Mix the contents of the Vacu-vial® by inverting it several times, allowing the bubble to move from one end to the other. Dry the outside of the vial.

7. Place the Vacu-vial® in the sample chamber.

8. Press **TEST** key.

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

After the reaction period is finished the measurement starts automatically.

The result is shown in the display in mg/l ortho-Phosphate.

**Zero accepted
prepare Test
press TEST**

**Countdown
5:00**

1.1 Methods

Notes:

1. This method is adapted from CHEMetrics.
2. Read the original test instruction and the MSDS (delivered with the test) before performing the test. MSDS also at www.chemetrics.com available.
3. Vacu-vials® is a registered trade mark of the company CHEMetrics, Inc. / Calverton, VA U.S.A.
4. Only ortho-Phosphate ions react.
5. Sulfide, Thiosulfate und Thiocyanate cause low test results.
6. ▲ PO_4
P
▼ P_2O_5

1.1 Methods

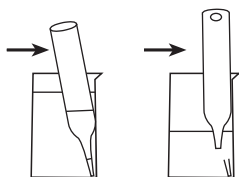
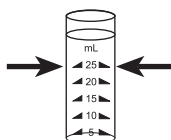


Phosphate 2, ortho with Vacu-vials® K-8513 (see Notes)

0.05 – 5 mg/l PO₄

Insert the adapter for 13 mm Ø vials.

prepare Zero
press ZERO



Zero accepted
prepare Test
press TEST

Countdown
3:00

1. Place the blank in the sample chamber. The blank is part of the test kit.

2. Press **ZERO** key.

3. Remove the blank from the sample chamber.

4. Fill the sample container to the 25 ml mark with the water sample.

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

2 drops A-8500 Activator Solution

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

7. Place one Vacu-vial® in the sample container. Snap the tip by pressing the vial against the side of the sample container. The Vacu-vial® breaks at the neck and the vial fills automatically. A small volume of inert gas remains in the Vacu-vial®.

8. Mix the contents of the Vacu-vial® by inverting it several times, allowing the bubble to move from one end to the other. Dry the outside of the vial.

9. Place the Vacu-vial® in the sample chamber.

10. Press **TEST** key.

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

After the reaction period is finished the measurement starts automatically.

The result is shown in the display in mg/l ortho-Phosphate.

1.1 Methods

Notes:

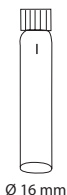
1. This method is adapted from CHEMetrics.
2. Read the original test instruction and the MSDS (delivered with the test) before performing the test. MSDS also at www.chemetrics.com available.
3. Vacu-vials® is a registered trade mark of the company CHEMetrics, Inc. / Calverton, VA U.S.A.
4. Only ortho-Phosphate ions react.
5. Sulfide, Thiosulfate und Thiocyanate cause low test results.
6. ▲ PO_4
P
▼ P_2O_5

1.1 Methods



Phosphate, acid hydrolyzable with Tube Test

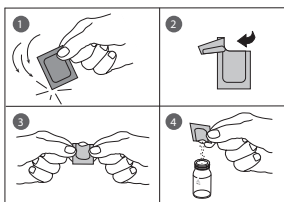
0.02 – 1.6 mg/l P (± 0.06 – 5 mg/l PO_4)



Insert the adapter for 16 mm Ø vials.

1. Open the white cap of one **digestion tube PO4-P Acid reagent** and add **5 ml of the water sample**.
2. Close the vial tightly with the cap and invert gently several times to mix the contents.
3. Heat the vials for **30 minutes** in the preheated reactor at a temperature of **100°C**.
4. After 30 minutes remove the vial from the reactor. **(CAUTION: The vials are hot!)**
Allow the vials to cool to room temperature.
5. Open the cooled digestion vial and add **2 ml 1.00 N Sodium Hydroxide solution** to the vial.
6. Close the vial with the cap and invert gently several times to mix the contents.
7. Place the vial in the sample chamber making sure that the Δ marks are aligned.
8. Press **ZERO** key.
9. Remove the vial from the sample chamber.

**prepare Zero
press ZERO**



**Zero accepted
prepare Test
press TEST**

**Countdown
2:00**

10. Add the contents of **one Phosphate Rgt. F10 Powder Pack** straight from the foil to the vial (Note 2).
11. Close the vial tightly with the cap and swirl several times to mix the contents (approx. 10-15 sec., Note 3).
12. Place the vial in the sample chamber making sure that the Δ marks are aligned.
13. Press **TEST** key.
Wait for a **reaction period of 2 minutes**.

After the reaction period is finished the measurement starts automatically.

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

1.1 Methods

Notes:

1. Use appropriate safety precautions and good lab technique during the procedure for most accurate results.
2. Use a funnel to add the reagent.
3. The reagent will not dissolve completely.
4. See page 137 for further information
5. Conversions:
 $\text{mg/l PO}_4 = \text{mg/l P} \times 3.07$
 $\text{mg/l P}_2\text{O}_5 = \text{mg/l P} \times 2.29$
6. ▲ PO_4
P
▼ P_2O_5

1.1 Methods

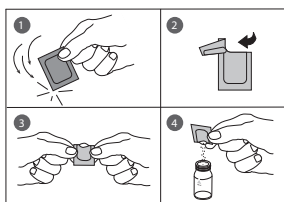


Phosphate, total with Tube Test

0.02 – 1.1 mg/l P (± 0.06 – 3.5 mg/l PO_4)



Ø 16 mm



**prepare Zero
press ZERO**

**Zero accepted
prepare Test
press TEST**

**Countdown
2:00**

Insert the adapter for 16 mm Ø vials.

1. Open the white cap of one **digestion tube PO4-P Acid reagent** and add **5 ml of the water sample**.
2. Add the contents of one **Potassium Persulfate F10 Powder Pack** straight from the foil to the vial (Note 2).
3. Close the vial tightly with the cap and invert several times to mix the contents.
4. Heat the vials for **30 minutes** in the preheated reactor at a temperature of **100°C**.
5. After 30 minutes remove the vial from the reactor. **(CAUTION: The vials are hot!)**
Allow the vials to cool to room temperature.
6. Open the cooled digestion vial and add **2 ml 1.54 N Sodium Hydroxide Solution** to the vial.
7. Close the vial with the cap and invert gently several times to mix the contents.
8. Place the vial in the sample chamber making sure that the Δ marks are aligned.
9. Press **ZERO** key.
10. Remove the vial from the sample chamber.
11. Add the contents of one **Phosphate Rgt. F10 Powder Pack** straight from the foil to the vial (Note 2).
12. Close the vial tightly with the cap and swirl several times to mix the contents (approx. 10-15 sec., Note 3).
13. Place the vial in the sample chamber making sure that the Δ marks are aligned.
14. Press **TEST** key.
Wait for a **reaction period of 2 minutes**.

After the reaction period is finished the measurement starts automatically.

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

1.1 Methods

Notes:

1. Use appropriate safety precautions and good lab technique during the procedure for most accurate results.
2. Use a funnel to add the reagent.
3. The reagent will not dissolve completely.
4. see also page 137
5. Conversions:

$$\text{mg/l PO}_4 = \text{mg/l P} \times 3.07$$

$$\text{mg/l P}_2\text{O}_5 = \text{mg/l P} \times 2.29$$

6. ▲ P



1.1 Methods

3

2

9

pH-value LR 5.2 – 6.8 with Tablet



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

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

**prepare Zero
press ZERO**

3. Press **ZERO** key.

4. Remove the vial from the sample chamber.

5. Add **one BROMOCRESOLPURPLE 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 Σ 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 BROMOCRESOLPURPLE tablets in black printed foil pack and marked with PHOTOMETER.
2. pH-Values below 5.2 and above 6.8 can produce results inside the measuring range. A confirmation/plausibility test (pH-meter) is recommend.
3. The accuracy of the colorimetric determination of pH-values depends on various boundary conditions (buffer capacity of the sample, salt contents etc.).
4. Salt error

Correction of test results (average values) for samples with salt contents of:

Indicator	Salt content		
Bromcresolpurple	1 molar - 0.26	2 molar - 0.33	3 molar - 0.31

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 %

1.1 Methods

3

3

0

pH-value 6.5 – 8.4 with Tablet



**prepare Zero
press ZERO**

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

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 Σ 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 confirmation/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 contents etc.).
5. Salt error

Correction of test results (average values) for samples with salt contents 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 %

1.1 Methods

3

3

1

pH-value 6.5 – 8.4 with Liquid Reagent



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 Σ marks are aligned.
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 Σ marks are aligned.
8. Press **TEST** key.

Zero accepted
prepare TEST
press Test

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

1.1 Methods

Notes:

1. When testing chlorinated water the residual chlorine contents can influence the color reaction of the liquid reagent. This can be avoided (without interfering the pH measurement) by adding a small crystal of Sodium thiosulfate ($\text{Na}_2\text{S}_2\text{O}_3 \times 5 \text{H}_2\text{O}$) to the sample before adding the PHENOL RED solution. PHENOL RED tablets already contain Thiosulfate.
2. Differing drop sizes may cause a discrepancy in results compared with tablets. This can be minimized 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 / 40°F and 10°C/ 50 °F.**

1.1 Methods

3

3

2

pH-value HR 8.0 – 9.6 with Tablet



prepare Zero
press ZERO

1. Fill a clean vial (24 mm Ø) with **10 ml of water sample**, close tightly with the cap.
2. Place the vial in the sample chamber making sure that the Σ marks are aligned.
3. Press **ZERO** key.
4. Remove the vial from the sample chamber.
5. Add **one THYMOLBLUE 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 Σ marks are aligned.
8. Press **TEST** key.

Zero accepted
prepare TEST
press Test

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

1.1 Methods

Notes:

1. For photometric determination of pH-values only use THYMOLBLUE tablets in black printed foil pack and marked with PHOTOMETER.
2. pH-Values below 8.0 and above 9.6 can produce results inside the measuring range. A plausibility/confirmation test (pH-meter) is recommended.
3. The accuracy of the colorimetric determination of pH-values depends on various boundary conditions (buffer capacity of the sample, salt contents etc.).
4. Salt error

Correction of test results (average values) for samples with salt contents of:

Indicator	Salt content		
Thymolblue	1 molar - 0.22	2 molar - 0.29	3 molar - 0.34

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 %

1.1 Methods



Potassium with Tablet

0.7 – 12 mg/l K



1. Fill a clean vial (24 mm Ø) with **10 ml of water sample**, close tightly with the cap.
2. Place the vial in the sample chamber making sure that the Σ marks are aligned.
3. Press **ZERO** key.
4. Remove the vial from the sample chamber.
5. Add **one Potassium 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 Σ marks are aligned.
8. Press **TEST** key.

prepare Zero
press ZERO

Zero accepted
prepare Test
press TEST

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

1.1 Methods

Notes:

1. If Potassium is present, a cloudy solution will result.

1.1 Methods





Silica/Silicon dioxide with Tablet

0.05 – 4 mg/l SiO₂




**prepare Zero
press ZERO**

**Countdown
5:00
start:** ⏱

1. Fill a clean vial (24 mm Ø) with **10 ml of 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 SILICA 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. Press [] key.
Wait for a **reaction period of 5 minutes**.

After the reaction period is finished proceed as follows:

8. Add **one SILICA PR tablet** straight from the foil to the same water sample and crush the tablet using a clean stirring rod.
9. Add **one SILICA No. 2 tablet** straight from the foil to the same water sample and crush the tablet using a clean stirring rod.
10. Close the cap tightly and swirl several times until the tablets are dissolved.
11. Place the vial in the sample chamber making sure that the  marks are aligned.
12. Press **TEST** key.
Wait for a **reaction period of 1 minute**.

After the reaction period is finished the measurement starts automatically.

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

**Zero accepted
prepare Test
press TEST**

**Countdown
1:00**

1.1 Methods

Notes:

1. The tablets must be added in the correct sequence.
2. Phosphate ions generally do not interfere under the given reaction conditions.
3. If Phosphate is known to be absent, the addition of the SILICA PR tablet may be omitted.
4. Conversion:
 $\text{mg/l Si} = \text{mg/l SiO}_2 \times 0.47$
5. ▲ SiO₂
▼ Si

1.1 Methods



Silica LR / Silicon dioxide LR with Powder Pack and Liquid Reagent

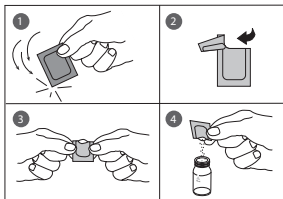
0.1 – 1.6 mg/l SiO₂



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

1. Fill each vial with **10 ml of the water sample**.
2. Add **0.5 ml Molybdate 3 reagent solution** into each vial.
3. Close the vials tightly with the caps and swirl several times to mix the contents (Note 1).
4. Press [↵] key.
Wait for a **reaction period of 4 minutes** (Note 2).

Countdown
4:00
start: ↵



After the reaction period is finished proceed as follows:

5. Add the contents of **one Silica Citric Acid F10 Powder Pack** straight from the foil into each vial.
6. Close the vials tightly with the caps and swirl several times to mix the contents.
7. Press [↵] key.
Wait for a **reaction period of 1 minute** (Note 3).

Countdown
1:00
start: ↵

After the reaction period is finished proceed as follows:

8. Place the vial (the blank) in the sample chamber making sure that the X marks are aligned.
9. Add the contents of **one LR Silica Amino Acid F F10 Powder Pack** straight from the foil into the vial (the sample).
10. Close the vial tightly with the cap and swirl several times to mix the contents.

1.1 Methods

**prepare Zero
press ZERO**

**Countdown
2:00**

**Zero accepted
prepare Test
press TEST**

11. Press **ZERO** key (blank is already placed in the sample chamber - see point 8).

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

After the reaction period is finished the zero-reading starts automatically.

12. Remove the vial from the sample chamber.
13. Place the vial (the sample) in the sample chamber making sure that the Σ marks are aligned.
14. Press **TEST** key.

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

Notes:

1. Close the vials with the cap immediately after adding the Molybdate 3 reagent solution; otherwise, low results can occur.
2. The given reaction time of 4 minutes refers to a water sample temperature of 20°C/70°F. At 30°C/85°F a reaction time of 2 minutes, at 10°C/ 50°F a reaction time of 8 minutes is required.
3. The given reaction time of 1 minute refers to a water sample temperature of 20°C/70°F. At 30°C/85°F a reaction time of 30 seconds, at 10°C/ 50°F a reaction time of 2 minutes is required.
4. Interferences:

Substance	Interference
Iron	large amounts interfere
Phosphate	does not interfere at concentrations less than 50 mg/l PO ₄ at 60 mg/l PO ₄ the interference is approx. – 2% at 75 mg/l PO ₄ the interference is approx. – 11%
Sulfide	interfere at all levels

Occasionally water samples contain silica compounds which reacts very slowly with Molybdate.

A pre-treatment with Sodium Hydrogen Carbonate and then with Sulfuric Acid will make these forms reactive with Molybdate (pre-treatment is given in "Standard Methods for the Examination of Water and Wastewater" under "Silica-Digestion with Sodium Bicarbonate").

5. ▲ SiO₂
▼ Si

1.1 Methods

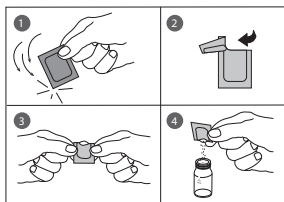


Silica HR / Silicon dioxide HR with Vario Powder Pack

1 – 90 mg/l SiO_2



**prepare Zero
press ZERO**



**Countdown
10:00
start:**

**Zero accepted
prepare Test
press TEST**

**Countdown
2:00**

1. Fill a clean vial (24 mm Ø) with **10 ml of the water sample** (Note 1), close tightly with the cap.
2. Place the vial in the sample chamber making sure that the Σ marks are aligned.
3. Press **ZERO** key.
4. Remove the vial from the sample chamber.
5. Add the contents of **one Silica Molybdate F10 Powder Pack** straight from the foil to the water sample.
6. Close the vial tightly with the cap and swirl several times to mix the contents.
7. Add the contents of **one Silica HR Acid Rgt. F10 Powder Pack** straight from the foil to the same water sample (Note 2).
8. Close the vial tightly with the cap and swirl several times to mix the contents.
9. Press [\leftarrow] key.
Wait for a **reaction period of 10 minutes**.

After the reaction period is finished proceed as follows:

10. Add the contents of **one Silica Citric Acid F10 Powder Pack** straight from the foil to the water sample (Note 3).
11. Close the vial tightly with the cap and swirl several times to mix the contents.
12. Place the vial in the sample chamber making sure that the Σ marks are aligned.
13. Press **TEST** key.

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

After the reaction period is finished the measurement starts automatically.

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

1.1 Methods

Notes:

1. Temperature of the sample should be 15°C / 60°F – 25°C / 80°F.
2. A yellow color develops if Silica or Phosphate is present.
3. This step removes any yellow color due to Phosphate.
4. Interferences:

Substance	Interference
Iron	large amounts interfere
Phosphate	does not interfere at concentrations less than 50 mg/l PO ₄ at 60 mg/l PO ₄ the interference is approx. – 2% at 75 mg/l PO ₄ the interference is approx. – 11 %
Sulfide	interfere at all levels

Occasionally water samples contain silica forms which reacts very slowly with Molybdate. The nature of these forms is not known.

A pre-treatment with Sodium Hydrogencarbonate and then with Sulfuric Acid will make these forms reactive to Molybdate (pre-treatment is given in "Standard Methods for the Examination of Water and Wastewater" under "Silica-Digestion with Sodium Bicarbonate").

5. ▲ SiO₂
▼ Si

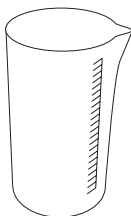
1.1 Methods



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. Fill 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. Fill 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 Σ marks are aligned.
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.

**prepare Zero
press ZERO**

1.1 Methods

8. Place the vial in the sample chamber making sure that the Σ 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. Exercise caution when handling sodium hypochlorite. The material has a very strong alkalinity and can cause corrosion. Contact with eyes, skin, clothes etc. should be avoided. Refer to precautionary information on the Sodium Hypochlorite label.
2. The tablets must be added in the correct sequence.
3. This method provides a fast, simple and portable test. By carefully following the procedure, an accuracy ± 1 weight% can be obtained.

1.1 Methods



Sulfate with Tablet

5 – 100 mg/l SO_4



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

**prepare Zero
press ZERO**

**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 result.

1.1 Methods

3 6 0

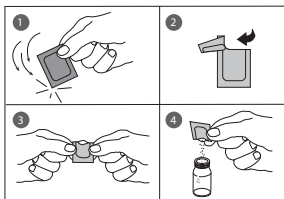
Sulfate with Powder Pack

5 – 100 mg/l SO_4



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

prepare Zero
press ZERO



4. Remove the vial from the sample chamber.
5. Add the contents of **one Sulpha 4/ F10 Powder Pack** straight from the foil to 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 Σ marks are aligned.

Zero accepted
prepare Test
press TEST

Countdown
5:00

8. Press **TEST** key.
Wait for a **reaction period of 5 minutes**.

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 result.

1.1 Methods

3

6

5

Sulfide with Tablet

0.04 – 0.5 mg/l S



Ø 24 mm

prepare Zero
press ZERO

1. Fill a clean vial (24 mm Ø) with **10 ml of water sample**, close tightly with the cap.
2. Place the vial in the sample chamber making sure that the Σ marks are aligned.
3. Press **ZERO** key.
4. Remove the vial from the sample chamber.
5. Add **one SULFIDE No. 1 tablet** to the water sample and crush the tablet using a clean stirring rod and dissolve the tablet.
6. Add **one SULFIDE No. 2 tablet** 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 Σ marks are aligned.

Zero accepted
prepare Test
press TEST

Countdown
10:00

9. Press **TEST** key.

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 in mg/l Sulfide.

1.1 Methods

Notes:

1. The tablets must added in the correct sequence.
2. Chlorine and other oxidizing agents which react with DPD do not interfere in the test.
3. To avoid loss of Sulfide ,collect the sample carefully with a minimum of aeration. It is essential to test the sample immediately after collection.
4. Ideally, the temperature of the water sample should be 20°C/ 70°F. Significant variation from this temperature can influence results.
5. Conversion:
$$H_2S = \text{mg/l S} \times 1.06$$
6. ▲ S
▼ H_2S

1.1 Methods

3

7

0

Sulfite with Tablet

0.1 – 5 mg/l SO_3



1. Fill a clean vial (24 mm Ø) with **10 ml of 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 SULFITE 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.

prepare Zero
press ZERO

Zero accepted
prepare Test
press TEST

Countdown
5:00

8. Press **TEST** key.

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

After the reaction period is finished the measurement starts automatically.

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

1.1 Methods

Notes:

1. ▲ SO_3
▼ Na_2SO_3

1.1 Methods

3

9

0

Urea with Tablet and Liquid Reagent

0.1 – 3 mg/l $(\text{NH}_2)_2\text{CO}$ / mg/l Urea



prepare Zero
press ZERO

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

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 8).

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 8).

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

9. Press [\leftarrow] 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.

Countdown
5:00
start: ⏸

1.1 Methods

Zero accepted
prepare Test
press TEST

Countdown
10:00

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 Σ marks are aligned.
14. Press **TEST** key.
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 in mg/l Urea.

Notes:

1. The sample temperature should be between 20°C / 70°F and 30°C / 85°F.
2. Testing should be completed within one hour after the sample has been taken.
3. The tablets must be added in the correct sequence.
4. Do not store reagent 1 below 10°C / 50°F or granulation is possible.
Store reagent 2 (Urease) in the refrigerator at a temperature of 4°C/40°F to 8°C/45°F.
5. The AMMONIA No. 1 tablet will only dissolve completely after the AMMONIA No. 2 tablet has been added.
6. Ammonium and chloramines are also measured during urea measurement.
7. Before analyzing 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.
8. Fill the vial with drops of the same size by holding the bottle vertically and squeeze slowly.

1.1 Methods



Zinc with Tablet

0.02 – 1 mg/l Zn



1. Fill a clean vial (24 mm Ø) with **10 ml of water sample**.
2. Add **one COPPER / ZINC LR tablet** straight from the foil to the water sample, crush the tablet using a clean stirring rod.
3. Close the vial tightly with the cap and swirl several times until the tablet is dissolved.
4. Place the vial in the sample chamber making sure that the Σ marks are aligned.
5. Press **ZERO** key.
Wait for a **reaction period of 5 minutes**.
After the reaction period is finished the measurement starts automatically.
6. Remove the vial from the sample chamber.
7. Add **one EDTA tablet** straight from the foil to the prepared vial 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. Place the vial in the sample chamber making sure that the Σ marks are aligned.
10. Press **TEST** key.
The result is shown in the display in mg/l Zinc.

prepare Zero
press ZERO

Countdown
5:00

Zero accepted
press ZERO
press TEST

1.1 Methods

Notes:

1. The tablets must be added in the correct sequence.
2. In the case of high levels of residual chlorine, perform the analysis with a dechlorinated water sample. To dechlorinate, add one DECHLOR tablet to the water sample (point 1). Crush and mix to dissolve the tablet. Then add the COPPER / ZINC LR tablet (point 2) and continue with the test procedure as described above.

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 your fingers.

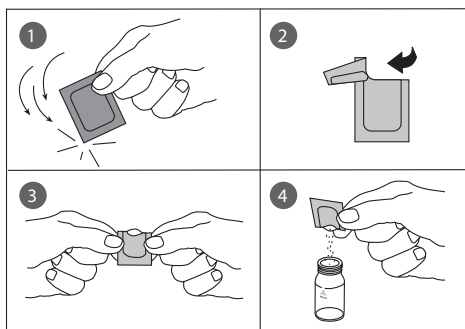
Liquid reagents:

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 color coding.

Note recommendation for storage (e.g. cool and dry).

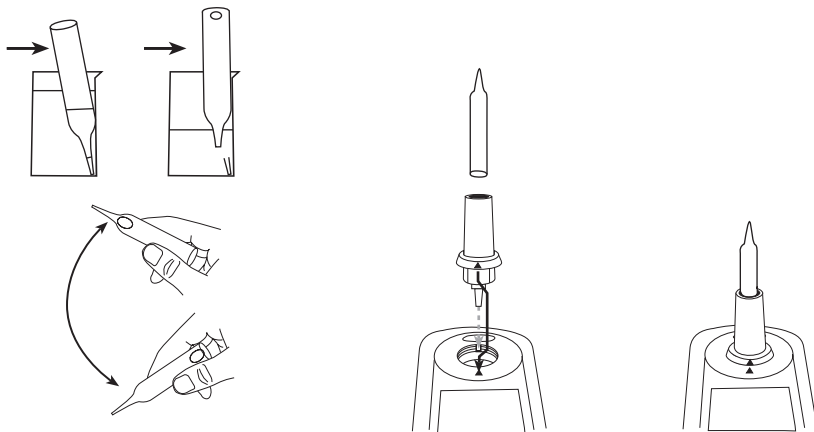
Powder Packs:



Vacu-vials® of CHEMetrics:

Vacu-vials® should be stored dark and at room temperature.

For further information see MSDS.



1.2.2 Cleaning of vials and accessories for analysis

Vials, caps and stirring rods should be cleaned thoroughly **after each analysis** to prevent cross contamination and external influence.

Procedure:

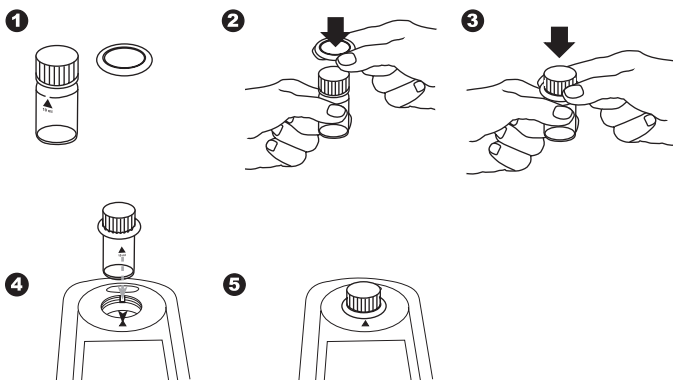
Clean vials and accessories after each analysis as soon as possible.

- Clean vials and accessories with laboratory detergent (e.g. Alconox[®] or Extran[®]).
- Rinse with tap water thoroughly.
- Depending on the procedure (see Notes), some tests require a rinse with diluted Hydrochloric acid solution.
- Rinse with deionized water thoroughly.

1.2.3 Guidelines for photometric measurements

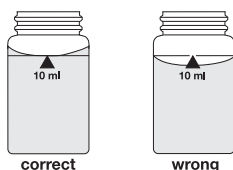
- Vials, caps and stirring rods should be cleaned thoroughly after each analysis to prevent external influences. Even minor reagent residues can cause errors in the test result.
- The outside of the vial must be clean and dry before starting the analysis. Clean the outside of the vials with a towel. Remove fingerprints or other marks.
- If there is no defined vial for the blank, the zeroing and the test should be carried out with the same vial as there may be slight differences in optical performance between vials.
- 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):

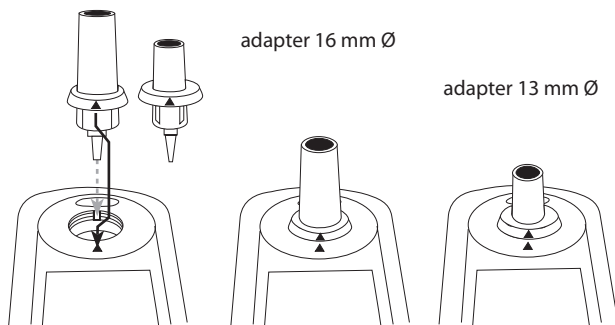


5. Always perform zeroing and test with closed vial cap. Only use cap with sealing ring.
6. Bubbles on the inside wall of the vial will lead to incorrect measurements. To prevent this, remove the bubbles by swirling the vial before performing the test.
7. Avoid spilling water into the sample chamber. 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 swab.
9. Large temperature differences between the instrument and the environment can lead to errors due to the formation of condensation in the area of the lens or on the vial.
10. To avoid possible errors caused by stray-light do not use the instrument in bright sunlight.

Correct filling of the vial:



Insertion of the adapter:



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 deionized 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 there is displayed "Overrange" 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

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Part 2

Instrument Manual

2.1 Operation

2.1.1 Set up

Before working with the colorimeter, insert the batteries (contents of delivery). See chapter 2.1.2 Saving data – Important Notes, 2.1.3 Replacement of batteries.

Before using the colorimeter, 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 initialize the user polynomial system

See chapter 2.4 Photometer settings.

2.1.2 Saving data – Important Notes

The batteries are necessary to retain stored results and colorimeter settings. Change the batteries as rapidly as possible to insure data retention—If the changing time exceeds 2 minutes all stored data and settings will be lost.

2.1.3 Replacement of batteries

See chapter 2.1.2 "Saving data - important notes" before replace batteries.

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 four screws (A) of the battery compartment cover (B).
5. Lift battery compartment cover at the notch (C) off.
6. Remove old batteries (D).
7. Insert 4 new batteries.

Be sure to note the correct polarity!

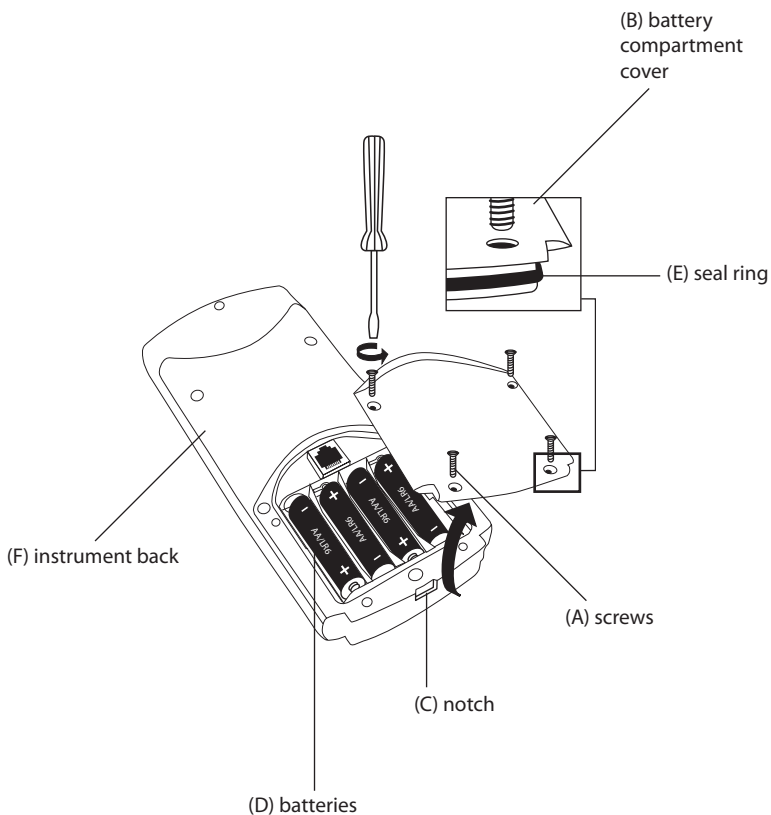
8. Replace the battery compartment cover.
Check the seal ring (E) of the notch if it is tight-fitting
9. Tighten the screws carefully.

CAUTION

Dispose of used batteries in accordance with all federal, state and local regulations.

2.1.4 Instrument (explosion drawing):

- (A) screws
- (B) battery compartment cover
- (C) notch
- (D) batteries: 4 batteries (Size: AA/LR6)
- (E) seal ring
- (F) instrument back



CAUTION:

To assure that the instrument water resistance is retained:

- seal ring (E) must be in position
- battery compartment cover (B) must be attached with the four screws provided

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2.2 Overview of function keys

2.2.1 Overview



Switching the colorimeter on or off



Press shift key to achieve figures key 0-9.
Keep the shift key depressed and press desired figures key.
e.g.: [Shift] + [1][1]



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 colorimeter 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



Decimal point

2.2.2 Displaying time and date:



Press ["clock"] key.

19:30:22 2008-06-15

The display shows:



After 15 seconds the colorimeter reverts to the previous display automatically
or press [↵] key or [ESC].

2.2.3 User-countdown

To set a user-controlled timer/countdown:



Press ["clock"] key.

19.30.20 2008-06-15

The display shows time and date:

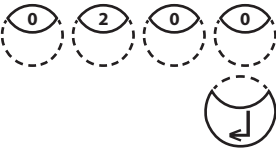


Press ["clock"] key.

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 entering comprises two digits each.
Enter minutes and seconds,
e.g.: 2 minutes, 0 seconds = [Shift] + [0][2][0][0].
Confirm with [↵] key.

Countdown
02:00
start: ↵

The display shows:
Start countdown with [↵] key.

After countdown has finished the colorimeter 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.

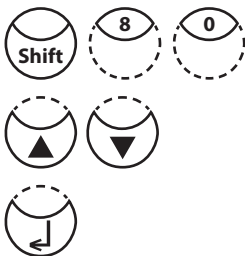
As long as the instrument is working (for example countdown or printing) the automatic switch off is inactive.

2.3.2 Selecting a method

>> 30 Alkalinity-m
35 Alkalinity-p
40 Aluminium

The display shows a selection:

There are two possibilities to select the required method:



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

b) press arrow 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.

Example:

100 Chlorine
0.02-6 mg/l Cl_2
Tablet
24 mm
DPD No 1
DPD No 3

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

Pressing the [F2] key the display shows a list with available chemical species and corresponding ranges. Changing chemical species see chapter 2.3.7 page 198.

320 Phosphate LRT

0.05-4 mg/l PO₄

0.02-1.3 mg/l P

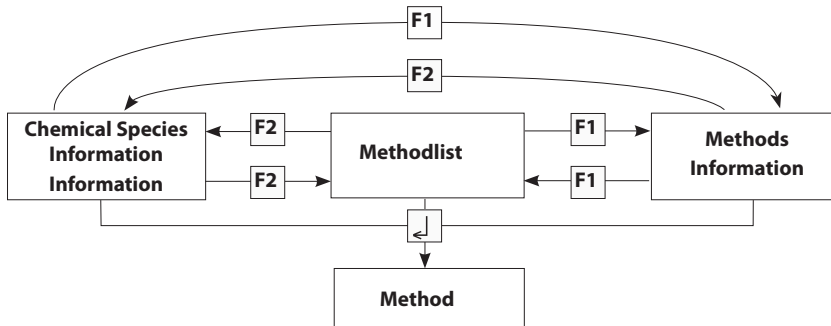
0.04-3 mg/l P₂O₅

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

Chlorine

>> diff
free
total

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



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 X 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:

- at 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)

For the compliance of 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.

Notes:

1. It is possible to finish the working countdown by pressing the [↶] key. Reading starts immediately. In this case the operator is responsible for ensuring the necessary reaction period by himself.

Non-compliance with reaction periods lead 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:

320 Phosphate LR T -----[▼]---->	320 Phosphate LR T <---- [▼] -----	320 Phosphate LR T
0.05-4 mg/l PO ₄	0.02-1.3 mg/l P	0.04-3 mg/l P ₂ O ₅
<---- [▲] -----	----- [▲] ----->	
1.00 mg/l PO ₄	0.33 mg/l P	0.75 mg/l P ₂ O ₅

In some testing parameters, an alternative form of the chemical species is available—if so, it is described in the test procedure(s). If the special species of a test result is changed, the displayed range is adjusted automatically. The last displayed chemical species is kept by the instrument and will be displayed if this method is used the next time. The arrows with the possible chemical species are printed below the notes of the method:

▲ PO₄
P
▼ P₂O₅

If a result is already stored in memory, it is not possible to change the chemical species.

2.3.8 Storing results



Press [STORE] key during 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 sample-taking place.)



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.

**Storage: 900
free records left**

**Storage: only 29
free records left**

Note:

The display shows the number of free data sets.

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 would be impossible to save additional test results.

2.3.9 Printing results (Infra-Red Interface Module) (optional)

If the IRIM (see chapter 2.5) is switched on and the printer is connected, it is possible to print out the test results (without saving it before).



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 Cl₂
Profi-Mode: no
2006-07-01 14:53:09
Test No.: 1
Code-Nr.: 007
4.80 mg/l Cl₂

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

2.3.10 Perform additional measurements



**Zero accepted
prepare Test
press TEST**

To perform additional tests using the same method:

- Press [TEST] key

The display shows:



Confirm with [TEST] key

or



- 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. [Shift] + [1][6][0] for Cyanuric acid.



Confirm with [↵] key.

2.3.12 Measure absorbance

Range: -2600 mAbs to +2600 mAbs

Method-No.	Title
900	mAbs 430 nm
910	mAbs 530 nm
920	mAbs 560 nm
930	mAbs 580 nm
940	mAbs 610 nm
950	mAbs 660 nm

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

900 mAbs 430 nm
-2600 mAbs - + 2600 mAbs
prepare Zero
press ZERO

The display shows e.g.:

Perform zeroing always with a filled (e.g. deionised water) vial.

Zero accepted
prepare Test
press TEST

The display shows:

Perform measurement of the sample.

500 mAbs

The display shows e.g.:

TIP: To ensure reaction times the User-Countdown may be helpful (chapter 2.2.3, page 194).

2.4 Photometer settings

<MODE-Menu>

Table of Mode-Functions

MODE-Function	No.	Description	Page
Calibration	40	Performance of fluoride	215
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User methods print	67	Print out all data that are stored with mode 64 (concentration) or mode 65 (polynomial)	230
User methods init	69	Initialize the user-method system (polynomial and concentration)	231

The selected settings are kept by the photometer also after it was switched off. To change photometer settings a new setting is required.

2.4.1 Purposely left blank [technical requirements]

2.4.2 Instrument basic settings 1

Selecting a language



Press [MODE], [Shift] + [1][0] keys.



Confirm with [↵] key.



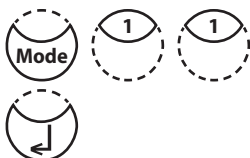
The display shows:

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



Confirm with [↵] key.

Key-beep



Press [MODE], [Shift] + [1][1] keys.

Confirm with [↵] key.

<Key-Beep>
ON: 1 OFF: 0

The display shows:



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

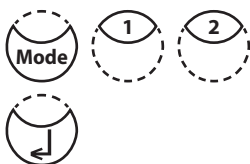
- Press [Shift] + [1] key to switch the key beep on.

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], [Shift] + [1][2] keys.

Confirm with [↵] key.

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

The display shows:

The entering comprises two digits each.

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

Enter year, month and day,
e.g.: 14. Mai 2006 = [Shift] + [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. = [Shift] + [1][5][0][7]



Confirm with [↵] key.

Note:

While conforming 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 by the countdown function.

It is possible to switch the countdown off for all methods:



Press [MODE], [Shift] + [1][3] keys.



Confirm with [↵] key.

<Countdown>
ON: 1 OFF: 0

The display shows:



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



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



Confirm with [↵] key.

Notes:

1. It is possible to finish 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 by himself.

Non-compliance with reaction periods lead 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], [Shift] + [1][4] keys.



Confirm with [↵] key.

<Signal-Beep>
ON: 1 OFF: 0

The display shows:



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



- Press [Shift] + [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 is switched off.

2.4.3 Printing of stored results

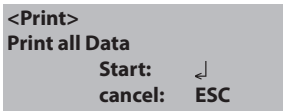
Printing all results



Press [MODE], [Shift] + [2][0] keys.



Confirm with [↵] key.



The display shows:

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



The display shows e.g.:

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

Note:

It is possible to cancel the entering by [ESC].
All stored data are printed out.
See chapter 2.5.1 Print of data.

Printing results of a selected time period



Press [MODE], [Shift] + [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 Mai 2006 = [Shift] + [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 Mai 2006 = [Shift] + [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 entering by [ESC].

If you want to print only results of one day enter the same date twice to characterize the period.

Printing results of a selected Code-No. range



Press [MODE], [Shift] + [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.: [Shift] + [1].



Confirm with [↵] key.

to _____

The display shows:

Enter numeric code number (up to 6 places) for the last required Code-No., e.g.: [Shift] + [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 entering 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-Nr. is 0) enter Zero [0] twice.

Printing results of one selected method



Press [MODE], [Shift] + [2][3] keys.



Confirm with [↵] key.

<Print>
>>20 Acid demand
30 Alkalinity-tot
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
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.

Note:

It is possible to cancel the entering by [ESC].

Printing Parameter



Press [MODE], [Shift] + [2][9] keys.



Confirm with [↵] key.

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

cancel:          ESC
```

The display shows:



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

```
<Flow Control>
is: Xon/Xoff
select:  [▲] [▼]
save:
cancel:  ↵ ESC
```

The display shows:



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



Confirm with [↵] key.



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



Press [Shift] + [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.
(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.

2.4.4 Recall / delete stored results

Recall all stored results



Press [MODE], [Shift] + [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 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], [Shift] + [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 Mai 2006 =
[Shift] + [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 Mai 2006 = [Shift] + [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 entering by [ESC].

If you want to recall only results of one day enter the same date twice to select the time period.

Recall results of a selected Code-No. range



Press [MODE], [Shift] + [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.: [Shift] + [1].



Confirm with [↵] key.

to _____

The display shows:

Enter numeric code number (up to 6 places) for the last required Code-No., e.g.: [Shift] + [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 entering 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-Nr. is 0) enter Zero [0] twice.

Recall results of one selected method



Press [MODE], [Shift] + [3][3] keys.



Confirm with [↵] key.

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

The display shows:

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



Confirm with [↵] key.

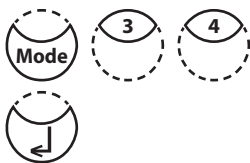
In case of differentiated methods select the required kind of determination and confirm with [↵] key.

```
<Storage>
method
30 Alkalinity-tot
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], [Shift] + [3][4] keys.

Confirm with [↵] key.

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

The display shows:



- Press [Shift]+[0] key to retain the data sets in memory.
- After pressing key [Shift] + [1] the following acknowledgment is displayed:

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

Press [↵] key to delete.

NOTE / CAUTION!

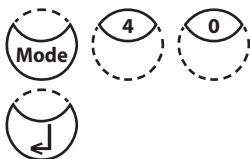
All stored test results will be deleted!

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

2.4.5 Calibration

Calibration Fluoride

Regard notes!




Press [MODE], [Shift] + [4][0] keys.

Confirm with [↵] key.

The display shows:

<Calibration>
170 Fluoride
Zero: deionized water
press ZERO

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.

3. Press **ZERO** key.
4. Remove the vial from the sample chamber.
5. Add **exactly 2 ml SPADNS reagent solution** to the water sample. **Caution: Vial is filled up to the top!**
6. Close the vial tightly with the cap and swirl gently several times to mix the contents.
7. Place the vial in the sample chamber making sure that the Σ marks are aligned.
8. Press **TEST** key.
9. Remove the vial from the sample chamber, empty the vial, rinse vial and cap several times and then fill the vial with exactly **10 ml Fluoride standard** (Concentration 1 mg/l F).
10. Add **exactly 2 ml SPADNS reagent solution** to the Fluoride standard.
Caution: Vial is filled up to the top!
11. Place the vial in the sample chamber making sure that the Σ marks are aligned.

Zero accepted
T1: 0 mg/l F
press TEST

T1 accepted
T2: 1 mg/l F
press TEST

Calibration accepted



12. Press **TEST** key.

The display shows:

Confirm with [\Leftarrow] key.

Back to method selection with [ESC] key.

Select method Fluoride with keys [Shift] + [1][7][0] + [\Leftarrow].

Note:

The same batch of SPADNS reagent solution must be used for adjustment and test. The adjustment process needs to be performed for each new batch of SPADNS reagent solution (see Standard Methods, 20th edition, 1998, APHA, AWWA, WEF 4500 F D., S. 4-82).

As the test result is highly dependent on exact sample and reagent volumes, the sample and reagent volumes should always be metered by using a 10 ml resp. 2 ml volumetric pipette (class A).

If an error message is displayed, please repeat adjustment.

Error, absorbance
T2>T1



User-Calibration

If a test method is user calibrated, the method name will be displayed in inverse order.

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 mathematical 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 of another test procedure.

Return to factory calibration:

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

Remarks:

The method "Fluoride" cannot be calibrated with mode 45 since the test requires a calibration related to the batch of the liquid reagent (SPADNS) (mode 40, chapter "calibration (fluoride)").

Table

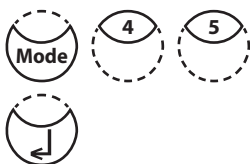
No.	Method	Recommended range for user user-calibration
20	Acid demand	1-3 mmol/l
35	Alkalinity-p	100-300 mg/l CaCO_3
30	Alkalinity-total	50-150 mg/l CaCO_3
40	Aluminum T	0.1-0.2 mg/l Al
50	Aluminum PP	0.1-0.2 mg/l Al
60	Ammonium T	0.3-0.5 mg/l N
62	Ammonium PP	0.3-0.5 mg/l N
65	Ammonium LR TT	1 mg/l N
66	Ammonium HR TT	20 mg/l N
85	Boron	1 mg/l B
80	Bromine	Calibration with basic test 100 Chlorine free
90	Chloride	10-20 mg/l Cl
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
105	Chlorine (KI) HR	70-150 mg/l Cl
120	Chlorine dioxide	Calibration with basic test 100 Chlorine free
130	COD LR	100 mg/l O_2
131	COD MR	500 mg/l O_2
132	COD HR	5 g/l $\text{O}_2 = 5000\text{mg}/\text{lO}_2$
150	Copper T	0.5-1.5 mg/l Cu

No.	Method	Recommended range for user user-calibration
153	Copper PP	0.5-1.5 mg/l Cu
157	Cyanide	0.1-0.3 mg/l CN
160	Cyanuric acid	30-60 mg/l Cys
165	DEHA T	200-400 µg/l DEHA
167	DEHA PP	200 µg/l DEHA
170	Fluoride	Calibration with 0 und 1 mg/l F through Mode 40
190	Hardness, Calcium	100-200 mg/l CaCO ₃
200	Hardness, total T	15-25 mg/l CaCO ₃
201	Hardness, total HR T	Calibration with basic test 200 Chlorine free
205	Hydrazine P	0.2-0.4 mg/l N ₂ H ₄
206	Hydrazine L	0.2-0.4 mg/l N ₂ H ₄
207	Hydrazine C	0.2-0.4 mg/l N ₂ H ₄
210	Hydrogen peroxide	Calibration with basic test 100 Chlorine free
215	Iodine	Calibration with basic test 100 Chlorine free
220	Iron T	0.3-0.7 mg/l Fe
222	Iron PP	0.1-4 mg/l Fe
223	Iron (TPTZ) PP	0.3-0.7 mg/l Fe
240	Manganese T	1-2 mg/l Mn
242	Manganese PP	0.1-0.4 mg/l Mn
243	Manganese HR PP	4-6 mg/l Mn
250	Molybdate T	5-15 mg/l Mo
252	Molybdate HR PP	10-30 mg/l Mo
265	Nitrate TT	10 mg/l N
270	Nitrite T	0.2-0.3 mg/l N
272	Nitrite LR PP	0.1-0.2 mg/l N
280	Nitrogen, total LR	10 mg/l N
281	Nitrogen, total HR	50-100 mg/l N
300	Ozone (DPD)	Calibration with basic test 100 Chlorine free
290	Oxygen, active	Calibration with basic test 100 Chlorine free
292	Oxygen, dissolved	possible against meter for dissolved oxygen
280	Nitrogen, total LR	10 mg/l N
281	Nitrogen, total HR	50-100 mg/l N
329	pH-Value LR	6.0-6.6
330	pH-Value T	7.6-8.0
331	pH-Value L	7.6-8.0
332	pH-Value HR	8.6-9.0
70	PHMB	15-30 mg/l
320	Phosphate LR T	1-3 mg/l PO ₄
321	Phosphate HR T	30-50 mg/l PO ₄
323	Phosphate, ortho PP	0.1-2 mg/l PO ₄
324	Phosphate, ortho TT	3 mg/l PO ₄
327	Phosphate 1, ortho C	20-30 mg/l PO ₄
328	Phosphate 2, ortho C	1-3 mg/l PO ₄
325	Phosphate, total TT	0.3-6 mg/l P
326	Phosphate, hydr. TT	0.3-0.6 mg/L P
340	Potassium	3 mg/l K
350	Silica	0.5-1.5 mg/l SiO ₂

No.	Method	Recommended range for user user-calibration
351	Silica LR PP	1 mg/l SiO_2
352	Silica HR PP	50 mg/l SiO_2
212	Sodium hypochlorite	8 %
360	Sulfate PP	50 mg/l SO_4
355	Sulfate T	50 mg/l SO_4
365	Sulfide	0.2-0.4 mg/l S
370	Sulfite	3-4 mg/l SO_3
390	Urea	1-2 mg/l $\text{CH}_4\text{N}_2\text{O}$
400	Zinc	0.2-0.4 mg/L Zn

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], [Shift] + [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

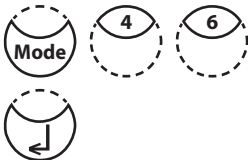
This chapter only applies for methods which can be user-calibrated.

100 Chlorine T
0.02-6 mg/l Cl2

Select the required method.

prepare ZERO
press ZERO

Instead of zeroing the instrument press [MODE], [Shift] + [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 [Shift] + [1] key to delete user-calibration.

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

The instrument goes back to Zero-query automatically.

2.4.6 Lab function

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 d, e, f are not longer included.



Press [MODE], [Shift] + [5][0] keys in succession.



Confirm with [↵] key.

<Profi-Mode>
ON : 1 OFF : 0

The display shows:



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



- Press [Shift] + [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. In case of stored test results the display shows "Profi-Mode" additionally.

The selected settings are kept by the photometer also after it was switched off. To change photometer setting a new setting is required.

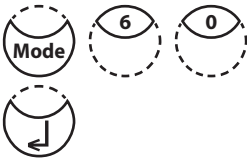
2.4.7 User operations

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.

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 than to switch off the automatic activated one if this one is not required.

User-method list, adaptation



Press [MODE], [Shift] + [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•Ammonium
....

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.

>> 30 Alkalinity-tot

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



>> 30•Alkalinity-tot

Select next method, activate or inactivate it and so on.



Confirm with [↵] key.

Cancel without storing by pressing [ESC] key.

Recommendation:

If only a few methods are required it is recommendable 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], [Shift] + [6][1] keys.



Confirm with [↵] key.

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

The display shows:



- Press [Shift] + [1] key to display all methods in the method selection list.
- Press [Shift] + [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], [Shift] + [6][2] keys.



Confirm with [↵] key.

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

The display shows:



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

Therefore, you need 2 to 14 standards of known concentration and one blank (deionized 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 these ranges to achieve best results.

*1000 mAbs = 1 Abs = 1 E (displayed)

Entering a User Concentration:



Press [MODE], [Shift] + [6][4] keys.



Confirm with [↵] key.

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

Enter-Procedure:

The display shows:



Enter a method-number in the range from 850 to 859, e.g.: [Shift] + [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 [Shift] + [0] or [ESC] key to go back to method-No. query.
- Press [Shift] + [1] key to start entry-mode.

wavelength:
1: 530 nm 4: 430 nm
2: 560 nm 5: 580 nm
3: 610 nm 6: 660 nm

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



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



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

Note:

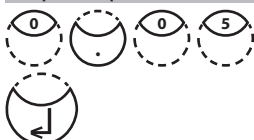
Please enter the required resolution according to the instrument presetting:

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

< User concentr.>
 prepare Zero
 press ZERO



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

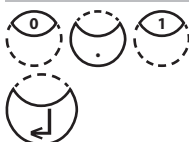


< User concentr.>
 S1: 0.05 mg/l
 prepare
 press TEST



S1: 0.05 mg/l
 mAbs: 12 ⏮

S1 accepted
 S2: + _____
 ⏮ | ESC | F1



Measurement procedure with standards of known concentration:

The display shows:

Prepare Zero and press [Zero] key.

Note:

Use deionized water or reagent blank value.

The display shows:

Enter the concentration of the first standard;
 e.g.: [Shift] + [0] [.] [0] [5]

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

Confirm with [⏮] key.

The display shows:

Prepare the first standard and press [Test] key.

The display shows the input value and the measured extinction value. Confirm with [⏮] key.

Enter the concentration of the second standard;
 e.g.: [Shift] + [0] [.] [1]

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

Confirm with [⏮] key.

S2: 0.10 mg/l
prepare
press TEST

S2: 0.10 mg/l
mAbs: 150 ↵

S2 accepted
S3: + _____
↵ | **ESC** | **F1** | **Store**



stored!

Prepare the second standard and press [Test] key.

The display shows the input value and the measured extinction value. Confirm with [↵] key.

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).

If all required standards or the maximum value of 14 standards are measured press [Store] key.

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:



Press [MODE], [Shift] + [6]/[5] keys.



Confirm with [↵] key.

<User polynoms>
choose no.: _____
(800-824)

The display shows:



Enter a method-number in the range from 800 to 824, e.g.: [Shift] + [8]/[0]/[0]



Overwrite polynom?
YES: 1, NO: 0

wavelength:
1: 530 nm 4: 430 nm
2: 560 nm 5: 580 nm
3: 610 nm 6: 660 nm



< User polynoms>
 $y = A + Bx + Cx^2 + Dx^3 + Ex^4 + Fx^5$
A: + _____



A: 1.32 _____ E+ _____



B: + _____



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



Confirm with [↵] key.

Note:

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

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

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

- Press [▲] or [▼] key to change between plus and minus sign
- Enter data of the coefficient A including decimal point, e.g.: [Shift] + [1] [.] [3] [2]
- Press [F1] key to reset numerical input.

Confirm with [↵] key.

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

Confirm with [↵] key.

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.

Enter measurement ranges from – 2600 to + 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

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

Note:

Please enter the required resolution according to the instrument presetting:

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)

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], [Shift] + [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.: [Shift] + [8][0][0]



Confirm with [↵] key.

M800
delete?
YES: 1, NO: 0

There is displayed the query:



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



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

The instrument goes back to mode menu automatically.

Print Data of User-Methods (Polynomials & Concentration)

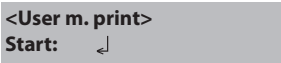
With these Mode function all data (e.g. wavelength, unit ...) of stored user-polynomial and concentration methods can be printed out or transferred with HyperTerminal to a PC.



Press [MODE], [Shift] + [6][7] keys.



Confirm with [↵] key.



The display shows:



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



The display shows e.g.:

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

Initialize User-Method-System (Polynomials & Concentration)

Power loss at the storage device will cause incoherent data. The user-method system must be initialized with this mode function to set it to a predefined state.

ATTENTION:

All stored user-methods (polynomial & concentration) are deleted with initialization.



Press [MODE], [Shift] + [6][9] keys.



Confirm with [↵] key.

<User m. init>
Start: ↵

The display shows:



Confirm with [↵] key.

Initializing?
YES: 1, NO: 0

There is displayed the query:



- Press [Shift] + [1] key to start initialization.



- Press [Shift] + [0] key to cancel without initialization.

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 the 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], [Shift] + [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 und 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 CaCO₃ 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 CaCO₃ 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 und 6000 mg/l and confirm with [↵] key.



pH value
0<=pH<=12
+ _ _ _ _



<Langelier>
Langelier
saturation index
0.00
Esc ↵

The display shows:

Enter the pH-value in the range between 0 and 12 and confirm with [↵] key.

The display shows the Langelier Saturation Index.

Press [↵] key to start new calculation.

Return to mode menu by pressing [ESC] key.

Operating error:

Examples:

CH<=1000 mg/l CaCO3!

Values out of defined range:

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.

Selection of temperature unit

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



Press [MODE], [Shift] + [7][1] keys.



Confirm with [↵] key.

<temperature>
1: °C 2: °F

The display shows:



Press [Shift] + [1] key to select degrees Celsius.



Press [Shift] + [2] key to select degrees Fahrenheit.

The instrument goes back to mode menu automatically.

2.4.9 Instrument basic settings 2

Adjusting display contrast



Press [MODE], [Shift] + [8][0] keys.



Confirm with [↵] key.



The display shows:



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



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



Confirm with [↵] key.

2.4.10 Instrument special functions /service

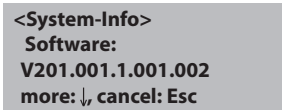
Colorimeter-Information



Press [MODE], [Shift] + [9][1] keys.



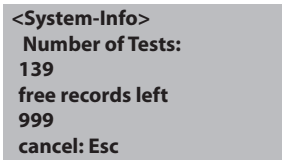
Confirm with [↵] key.



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.



Finish with [ESC] key.

2.5 Data transfer

To print data or to transmit them to a PC the optional available IRIM (Infra-Red Interface Module) is required.

2.5.1 Print of data

Beside the IRIM-module the following printer is required to print data directly using the USB Interface of the modul: HP Deskjet 6940.

2.5.2 Data transfer to a personal computer

Beside the IRIM a transfer program, is required to transmit test results.

Please find detailed information in the IRIM manual or at our homepage in the download-area.

2.5.3 Internet-Updates

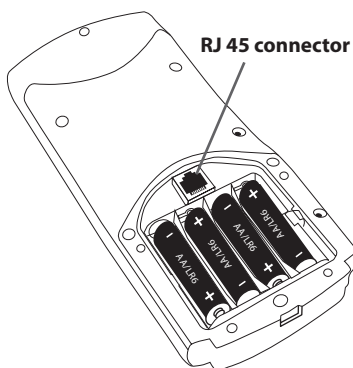
To connect the instrument with the serial interface of a computer the optional available connection cable with integrated electronic system is necessary.

It is possible to update new software applications and additional languages via internet. Please find detailed information at our homepage on the download-area (as soon as available).

For information on how to open and close the battery compartment cover, see chapter 2.1.3.

Note:

To prevent loss of stored test results store or print out them before performing an Update. If the update procedure will be interrupted (eg. interruption of connection, LoBat., etc.) the instrument isn't able to work (no display answer). The instrument will only be able to work again after a complete data transfer.



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Part 3

Contents & Delivery

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 content of MC500:



1 Photometer in plastic case



4 batteries (size; Type AA/LR 6)



1 Instruction manual



1 Guarantee declaration



1 Certificate of compliance



Adapter for 16 mm Ø (Outside Diameter) vials



Adapter for 13 mm Ø (Outside Diameter) vials



Round vials with cap, height 48 mm, Ø 24 mm (Outside Diameter)



Round vials with cap, height 90 mm, Ø 16 mm (Outside Diameter)



Cleaning brush



Stirring rod, plastic

Reagent sets, IRIM-modul and connection cable with integrated electronic system 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
Serial Interface	IR-interface for data transfer RJ45 connector for internet-updates (see chapter 2.5.3)
Light source	light-emitting diode – photosensor – pair arrangement in a transparent measurement chamber Wavelength ranges: $\lambda_1 = 530 \text{ nm IF } \Delta \lambda = 5 \text{ nm}$ $\lambda_2 = 560 \text{ nm IF } \Delta \lambda = 5 \text{ nm}$ $\lambda_3 = 610 \text{ nm IF } \Delta \lambda = 6 \text{ nm}$ $\lambda_4 = 430 \text{ nm IF } \Delta \lambda = 5 \text{ nm}$ $\lambda_5 = 580 \text{ nm IF } \Delta \lambda = 5 \text{ nm}$ $\lambda_6 = 660 \text{ nm IF } \Delta \lambda = 5 \text{ nm}$ IF = Interference filter
Wavelength accuracy	$\pm 1 \text{ nm}$
Photometric accuracy*	2% Fs (T = 20°C – 25°C)
Photometric resolution	0.005 A
Operation	Acid and solvent resistant touch-sensitive keyboard with integral beeper as acoustic indicator.
Power supply	4 batteries (Type AA/LR 6); lifetime: approx. 26 h continuous use or 3500 tests
Auto off	20 minutes after last function, 30 seconds acoustical signal before switch off
Dimensions	approx. 210 x 95 x 45 mm (unit) approx. 395 x 295 x 106 mm (case)
Weight (unit)	approx. 450 g
Working condition	5 – 40°C at max. 30 – 90% relative humidity (without condensation)
Language options	English, German, French, Spanish, Italian, Portuguese, Polish; further languages via Internet-Update
Storage capacity	1000 data sets

Subject to technical modification!

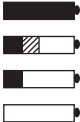
* measured with standard solutions

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 (\triangle Extinction E) 1000 mAbs = 1 Abs \triangle 1 A \triangle 1 E
µg/l	(= ppb) Microgram per liter
mg/l	(= ppm) Milligram per liter
g/l	(= ppth) gram per liter
KI	Potassium iodide
K _{S 4.3}	Acid demand to pH 4.3 – this method is similar to the 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 of 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-naphthol
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	Resolution
Overrange	reading is exceeding the range water sample is too cloudy too 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
Storagesystem error use Mode 34	power failure	insert or change battery. Delete data with Mode 34
Battery warning 	full capacity warning signal every 3 minutes warning signal every 12 seconds warning signal, the instrument switches itself off	capacity of the battery is too low; change the batteries
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
Zero not accepted	Light absorption is too great or too low	Refer to chapter 2.3.4 Performing Zero (page 196) Clean sample chamber. Repeat zeroing.

Display	Possible Causes	Resolution
<p>???</p> <p>Example 1</p> <p>0,60 mg/l free Cl ??? comb Cl 0,59 mg/l total Cl</p> <p>Example 2</p> <p>Underrange ??? comb Cl 1,59 mg/l total Cl</p> <p>Example 3</p> <p>0,60 mg/l free Cl ??? comb Cl Overage</p>	<p>The calculation of a value (e.g. combined Chlorine) is not possible</p>	<p>Test procedure correct? If not – repeat test</p> <p>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.</p> <p>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.</p> <p>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 with a diluted sample.</p>
<p>Error absorbance e.g.: T2>T1</p>	<p>calibration of Fluoride was not correct</p>	<p>Repeat calibration</p>

3.6.2 General problems

Problem	Possible Causes	Resolution
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 test Chlorine 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.



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