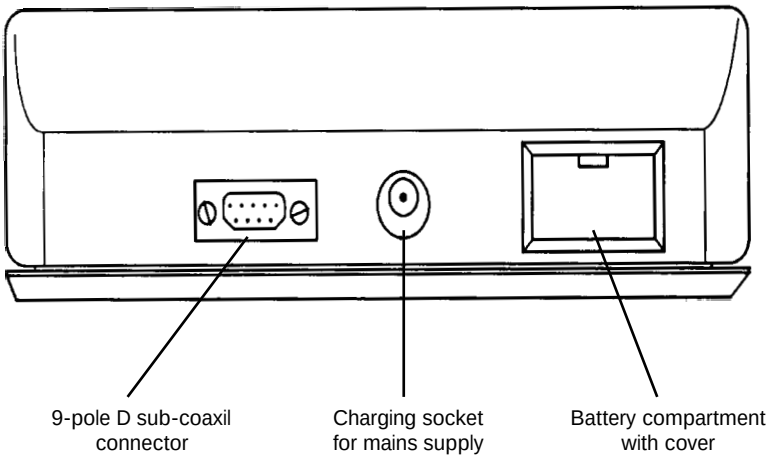
Photometer PC 22

GB **Operating Instructions**

Front View

Back View



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1. Photometer

1.1. Important notes

CAUTION

Reagent tablets are formulated exclusively for chemical analysis and must not be used for any other purpose. Reagent tablets must not get into the hands of children. Some of the ingredients contain substances which are not entirely harmless environmentally. Become familiar with the constituents and take proper care when disposing of the test solution.

CAUTION

On the bottom right of the SMD board is a lithium battery:
Panasonic Br 2/3 A, 3V or equivalent.
This lithium battery supplies the data memory and real-time clock. This will on average last 10 years. You are advised to change this battery after 5 years. When the battery is exchanged, the stored values are lost.

CAUTION

The rechargeable battery should be charged in situ using the external charger unit. **Do not** use the instrument with the external charger connected, as the amount of electro-magnetic radiation emitted is not guaranteed to be within CE conformance limits.

1. Photometer

1.2. Items supplied

1 Photometer in plastic case
1 9 V rechargeable battery
1 15 V recharger
4 Cells
4 Stoppers
1 Graduated beaker, volume 100 ml
1 Cleaning brush
1 Glass stirring rod
1 Permanent marker
1 Clean-up set
3 Reference filters
1 Instruction manual
1 Guarantee slip

Reagents are not included in the basic kit. These should be ordered from the current catalogue to suit the customers' requirements.

1. Photometer

1.3. Technical data

Display	4-line 16-character alphanumeric LCD display
Interface	V24 interface for printer or PC connection. 9-pole D sub-coaxial connector. Data format ASCII, baud rate 1200, 8-bit data, no parity, 1 start-bit, 1 stop-bit. Pin assignation: Pin 1 = Free — Pin 6 = Free Pin 2 = Rx Data — Pin 7 = RTS Pin 3 = Tx Data — Pin 8 = CTS Pin 4 = Free — Pin 9 = Free Pin 5 = GND
Light Source	Temperature-compensated LEDs and photosensor amplifier in protected cell compartement. Wave Length Ranges: λ_1 = 470 nm — $\Delta\lambda$ (nm) = 30 λ_2 = 528 nm (filter) — $\Delta\lambda$ (nm) = 30 λ_3 = 580 nm — $\Delta\lambda$ (nm) = 30 λ_4 = 605 nm — $\Delta\lambda$ (nm) = 30 λ_5 = 660 nm — $\Delta\lambda$ (nm) = 30
Operation	Acid and solvent resistant touch-sensitive keyboard with integral beeper as acoustic indicator.
Power Supply	9 V rechargeable (NiCd) battery pack and external 15 V mains connection; integral overload protection.
Charging Time	approx. 20 hours for an empty rechargeable (NiCd) battery
Recharger	15 V= / 100 mA, plus polarity: pluspole inside
Battery Working Life	approx. 120 minutes with one NiCd battery
Measuring Tolerance	± 1% of full scale reading
Dimensions (H x B x D)	92 x 180 x 220 mm (Unit) 95 x 440 x 340 mm (Case)
Humidity	30 – 90% relative humidity (without condensation)
Working Range	0 – 50 °C
Cut-Out Cycle	approximately 20 minutes after last function without loss of data
Language Options	Option of German, English, French, Spanish, Italian, Dutch, Danish and Polish.
Self-Diagnosis	Self-test after switching on unit and additionally automatic self-diagnosis after every 200 series of measurements.
Storage Capacity	approximately 1000 data records

1. Photometer

1.4. Test Parameters

Test No.	Test	λ	Symbol	Measurement Range		Method [Literature Ref.]
005	Alkalinity-m	605	Alk	5.0 - 200	mg/l $CaCO_3$	Acid / Indicator [1,2,5]
006	Alkalinity-p	528	Alk-p	5.0 - 500	mg/l $CaCO_3$	Acid / Indicator [1,2,5]
010	Aluminium	528	Al	0.01 - 0.3	mg/l Al	Eriochrome-Cyanine R [2]
015	Ammonia	660	NH_4	0.02 - 1.0	mg/l NH_4	Indophenol [2,3]
019	Boron	470	B	0.1 - 2.5	mg/l B	Azomethine H [3]
020	Bromine	528	Br	0.25 - 13	mg/l Br	DPD [5]
025	Chlorine	528	Cl */**/***	0.02 - 1.5	mg/l Cl_2	DPD [1,2,3]
026	Chlorine	528	Cl */**/***	0.1 - 6.0	mg/l Cl_2	DPD [1,2,3]
027	Chlorine HR (KI)	470	Cl ***	5.0 - 250	mg/l Cl_2	KI / Acid [5]
030	Chlorine dioxide	528	ClO_2	0.04 - 2.8	mg/l ClO_2	DPD glycine [2]
031	Chloride	528	Cl-T	0.5 - 25	mg/l Cl	Silver nitrate / turbidity
065	Copper	580	Cu *	0.02 - 1.0	mg/l Cu	Zincon [5]
070	Copper	528	Cu */***	0.05 - 5.0	mg/l Cu	Biquinoline [4]
035	Cyanuric acid	528	Cys	1.0 - 80	mg/l Cys	Melamine
045	Fluoride	580	F	0.05 - 1.4	mg/l F	SPADNS [2]
050	Hardness (Ca)	528	$CaCO_3$	5.0 - 100	mg/l $CaCO_3$	Murexide [4]
051	Hardness (total)	528	$CaCO_3$	2.0 - 50	mg/l $CaCO_3$	Metalphthalein [3]
054	Hydrazine	470	N_2H_4	0.05 - 0.5	mg/l N_2H_4	Dimethylamino-benzaldehyde [3]
150	Hydrogen peroxide	528	H_2O_2	0.05 - 3.0	mg/l H_2O_2	DPD / Catalyst [5]
055	Iodine	528	I	0.05 - 3.6	mg/l I	DPD [5]
040	Iron	528	Fe	0.01 - 1.0	mg/l Fe	PPST [3]
975	mAbs	470	Abs	0 - 1000	mAbs	-
980	mAbs	528	Abs	0 - 1000	mAbs	-
985	mAbs	580	Abs	0 - 1000	mAbs	-
990	mAbs	605	Abs	0 - 1000	mAbs	-
995	mAbs	660	Abs	0 - 1000	mAbs	-

free = * combined = ** total = ***

1. Photometer

Test No.	Test	λ	Symbol	Measurement Range		Method [Literature Ref.]
073	Manganese	470	Mn	0.05 - 4.0	mg/l Mn	Formaldoxime
075	Molybdate	470	MoO_4	0.5 - 50	mg/l MoO_4	Thioglycolate [4]
085	Nitrate	528	NO_3	0.08 - 1.0	mg/l NO_3	Zn-Reduction / NED [3]
086	Nitrate HR	470	NO_3	1 - 25	mg/l NO_3	Zn-Reduction 1-Naphthylamine-7-sulfuric acid
090	Nitrite	528	NO_2	0.01 - 0.5	mg/l NO_2	N(1-naphthyl)-ethylenediamine [2,3]
091	Nitrite HR	470	$NaNO_2$	10 - 1500	mg/l $NaNO_2$	Acid / Potassium iodide
095	Ozone	528	O_3	0.02 - 1.0	mg/l O_3	DPD / Glycine [5]
100	Ozone	605	O_3	0.01 - 0.5	mg/l O_3	Indigo trisulfonate [2]
129	Oxygen	528	O_2	10 - 500	µg/l O_2	Chemetrics™
105	pH	580	pH	5.2 - 6.8		Bromocresolpurple [5]
110	pH	528	pH	6.5 - 8.4		Phenolred [5]
115	pH	580	pH	8.0 - 9.6		Thymolblue [5]
120	Phosphate LR	660	PO_4	0.05 - 4.0	mg/l PO_4	Ammonium Molybdate [2,3]
125	Phosphate HR	470	PO_4	10 - 100	mg/l PO_4	Vanadomolybdate [2]
800	Poly 1	(λ)	P1	-		
810	Poly 2	(λ)	P2	-		
820	Poly 3	(λ)	P3	-		
060	Potassium	580	K	0.5 - 12	mg/l K	Tetraphenylborate / Turbidity [4]
130	Silica	580	SiO_2	0.05 - 4.0	mg/l SiO_2	Silicomolybdate [2,3]
080	Sodium hypochlorite	470	NaClO	0.2 - 16	% NaClO	Potassium iodide [5]
135	Sulfate	605	SO_4	2.0 - 100	mg/l SO_4	Barium chloride / Turbidity [5]
140	Sulfide	605	S	0.04 - 0.5	mg/l S	DPD / Catalyst [3,4]
145	Sulfite	580	Na_2SO_3	1.0 - 100	mg/l Na_2SO_3	Indicator reduction
155	Zinc	580	Zn	0.02 - 1.0	mg/l Zn	Zincon [3]

free = * combined = ** total = ***

1. Photometer

1.5. Notes on colorimetric methods

The test methods and the tablet formulations are based on internationally recognised test methods, many of which are included in national and/or international standards.

1.6. Literature

1) Deutsche Einheitsverfahren zur Wasser-, Abwasser- und Schlammuntersuchung, DIN 38 404, Teil 4, Verlag Chemie

2) Standard Methods for the Examination of Water and Wastewater, 18th Edition, 1992

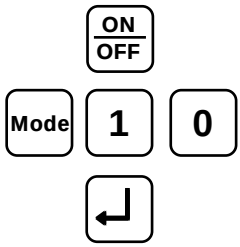
3) Photometrische Analyseverfahren, Schwedt Wissenschaftliche Verlagsgesellschaft GmbH, Stuttgart 1989.

4) Photometrische Analyse, Lange / Vejdelek, Verlag Chemie 1980

5) Colorimetric Chemical Analytical Methods, 9th Edition, Lovibond®

2. Function Modes

2.1. Language options - Mode 10



1. Switch unit on by pressing the ON/OFF button.
2. After "Autotest" has cleared press MODE [1] [0] keys in succession.
3. Confirm input with ENTER.

Select Language

D=0 GB=1 F=2 I=3

E=4 NL=5 PL=6 DK=7

then appears in the display.

4. Select language required by pressing the corresponding key, e.g. [1] for English.

English ? "↵ "

is then displayed.

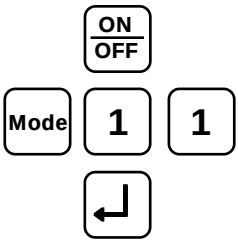
5. Confirm language selected by pressing ENTER.

Note

The Photometer will revert to German when the **lithium** battery is replaced.

2. Function Modes

2.2. Acoustic signal (beeper) - Mode 11



1. Switch unit on by pressing the ON/OFF button.
2. After "Autotest" has cleared press MODE [1] [1] keys in succession.
3. Confirm input with ENTER.

Beeper off ! "↵ " = ON
Beeper on ! "↵ " = OFF

then appears in the display.

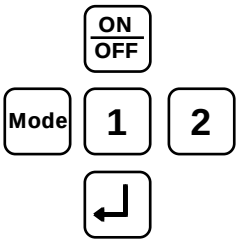
4. Switch beeper on or off by pressing ENTER.
5. To stay in the current beeper function, press ON/OFF button twice in succession.

Note

For determinations using the timing function, an acoustic signal will sound in the last 10 seconds before the full time has elapsed, even if the beeper is switched off.

2. Function Modes

2.3. Date and time entries - Mode 12



1. Switch unit on by pressing the ON/OFF button.
2. After "Autotest" has cleared press MODE [1] [2] keys in succession.
3. Confirm input with ENTER.

Enter date
DD . MM . YYYY

then appears in the display.

The day and month each comprise two digits, and the year four digits.

Example: 14 february 1996 = 14 02 1996
Enter 14 02 1996 by pressing the relevant keys.

4. Confirm entry by pressing ENTER.

Enter time
HH . MM

then appears in the display.

Hours and minutes each comprise 2 digits, based on a 24 hour clock.

Example: 3.07 pm = 15.07
Enter 15 07 by pressing the relevant keys.

5. Confirm entry by pressing ENTER.

Note

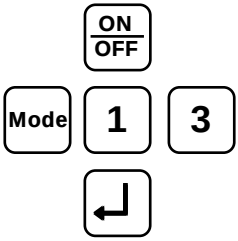
If the date and time entered are not feasible, the cursor returns to the first character of the display. Repeat input with correct data.

2. Function Modes

2.4. Switching "Timer Function" ON/OFF - Mode 13

Some methods require a time delay for full colour development. This is incorporated in the method as standard by means of the timer function and is normally in the ON-mode when the instrument is supplied.

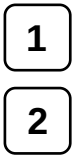
If so desired this timer function can be switched off as follows:



1. Switch unit on by pressing the ON/OFF button.
2. After "Autotest" has cleared press MODE [1] [3] keys in succession.
3. Confirm input with ENTER.

Delay AUTO
YES = 1 NO = 2

then appears in the display.



4. Set with time function ON by pressing key [1].

   Set with time function OFF by pressing key [2].

Notes

The photometer reverts to timer function ON should the **lithium** battery be replaced.

If the timer function is in the OFF-mode the operator is responsible for ensuring the necessary waiting time for full colour development is allowed.

2. Function Modes

2.5. Printing stored data - Modes 20, 21, 22, 23

Note

A test result may be printed immediately after completing the test by pressing the PRINT key, provided the printer has been connected and switched on correctly. If a result is only to be printed out at a later occasion, it is essential the result is stored by pressing the STORE key, **immediately** after the result has been displayed.

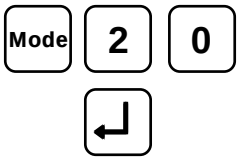
By linking up a printer to the photometer, the stored data can be printed out on the basis of a number of criteria:

All data	- Mode 20
Sequential Number	- Mode 21
Code Number (eg for operator or site)	- Mode 22
Method	- Mode 23

No data Indicates that no data has been stored for that mode.

No printer Indicates that the printer has not been attached to the unit or it has not been switched on.

All data - Mode 20



1. Press MODE [2] [0] keys in succession.

2. Confirm input with ENTER.

Print all Data

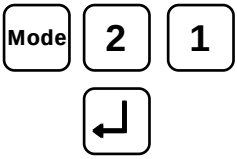
"PRINT" then appears in the display.

3. Press the PRINT key.

All stored data are printed out in chronological order.

2. Function Modes

Sequential number - Mode 21

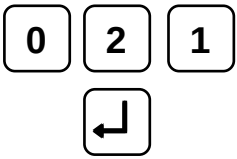


1. Press MODE [2] [1] keys in succession.

2. Confirm input with ENTER.

Print Test No.
from Test No.

then appears in the display.

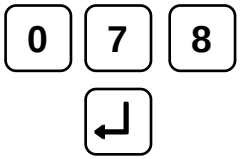


3. Enter required test number, using up to 3 figures (e.g. 021).

4. Confirm entry by pressing ENTER.

to Test No.

then appears in the display.



5. Enter required test number, using up to 3 figures (e.g. 078).

6. Confirm entry by pressing ENTER.

"PRINT"

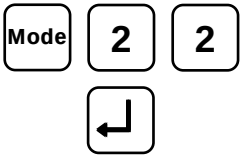
then appears in the display.

7. Press PRINT.

Data within the range set is then printed.

2. Function Modes

Code number - Mode 22

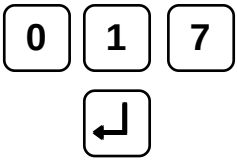


1. Press MODE [2] [2] keys in succession.

2. Confirm input with ENTER.

Print Code No.
from Code No.

then appears in the display followed by:

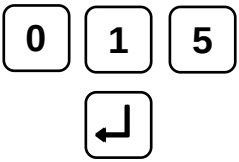


3. Enter required code number (max. 6 digits).

4. Confirm entry by pressing ENTER.

to Code No.

then appears in the display.



5. Enter required code number (max. 6 digits).

6. Confirm entry by pressing ENTER.

"PRINT"

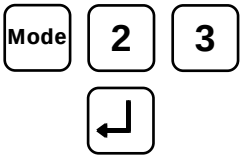
then appears in the display.

7. Press PRINT.

Data within the range set is then printed.

2. Function Modes

Method - Mode 23



1. Press MODE [2] [3] keys in succession.

2. Confirm input with ENTER.

Print "Method"
No. or "↑↓"

then appears in the display.

3. Select method by **either**:

a) entering the relevant test number (see page 9 and 10) e.g. enter [2] [0], then appears in the display:

Print "Method" No. 20

or

b) using the scroll keys "↑↓" until the relevant method is displayed e.g.:

Print "Method" Br 020

4. Confirm selection by pressing ENTER.

Br "Print"

then appears in the display.

5. Press PRINT.

Data for the required method, e.g. for Bromine is then printed.

Notes

no data

NO METHODE
If the PRINT key is pressed without previously selecting a method, this error message appears.

Data records remain stored in the photometer after they have been printed out.
Data deletion is done separately (see mode 34).

2. Function Modes

2.6. List stored data - Modes 30, 31, 32, 33

As with printing, only stored data may be listed. If not already switched on, switch on the unit and wait for "Autotest" to clear.

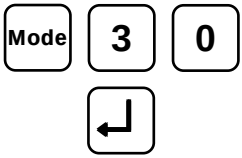
The stored data can be listed in the display by various criteria:

All Data	- Mode 30
Sequential Number	- Mode 31
Code Number	- Mode 32
Method	- Mode 33

If there is no data in the memory, this message is displayed:

No data

All data - Mode 30



1. Press MODE [3] [0] keys in succession.

2. Confirm input with ENTER.

Display all data "↑"

then appears in the display.

3. By pressing SCROLL UP, the first data record appears in the display.

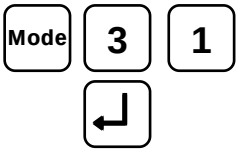
4. By pressing SCROLL UP again, the next data record is displayed.

5. By pressing SCROLL DOWN, the previous data record is displayed.

6. By pressing ENTER, the unit reverts to working mode.

2. Function Modes

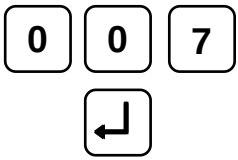
Sequential number - Mode 31



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

2. Confirm input with ENTER.

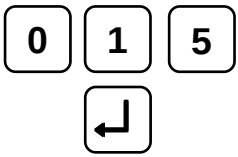
Display Test No.
from Test No. then appears in the display.



3. Enter required test number, using up to 3 figures (e.g. 007).

4. Confirm entry with ENTER.

to Test No. then appears in the display.



5. Enter required test number, using up to 3 figures (e.g. 015).

6. Confirm entry by pressing ENTER.

Display "↑" then appears in the display.

7. By pressing SCROLL UP, the first data record in the selected range set appears in the display.

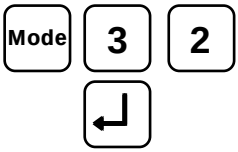
8. By pressing SCROLL UP again, the next data record is displayed.

9. By pressing SCROLL DOWN, the previous data record is displayed.

10. By pressing ENTER, the unit reverts to working mode.

2. Function Modes

Code number - Mode 32

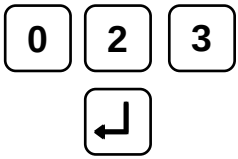


1. Press MODE [3] [2] keys in succession.

2. Confirm input with ENTER.

Display Code No.
from Code No.

then appears in the display.

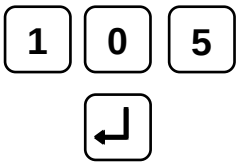


3. Enter required code number (max. 6 digits).

4. Confirm entry with ENTER.

to Code No.

then appears in the display.



5. Enter required code number (max. 6 digits).

6. Confirm entry by pressing ENTER.

Display "↑"

then appears in the display.

7. By pressing SCROLL UP, the first data record in the selected range set appears in the display.

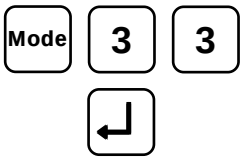
8. By pressing SCROLL UP again, the next data record is displayed.

9. By pressing SCROLL DOWN, the previous data record is displayed.

10. By pressing ENTER, the unit reverts to working mode.

2. Function Modes

Method - Mode 33



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

2. Confirm input with ENTER.

Display "Method"

No. or "↑↓"

then appears in the display.

3. Select method by **either**:

a) entering the relevant test number (see page 9 and 10) e.g. enter [2] [0], which is then displayed:

Display "Method" No.20

or

Display "Method" Br 020

b) using the SCROLL keys "↑↓" until the relevant method is displayed e.g.:

4. Confirm input with ENTER.

Br "↑"

then appears in the display.

No method

If an incorrect number is entered this error message appears in the display:

5. By pressing SCROLL UP, the first data record in the selected range set appears in the display.

6. By pressing SCROLL UP again, the next data record is displayed.

7. By pressing SCROLL DOWN, the previous data record is displayed.

8. By pressing ENTER, the unit reverts to working mode.

2. Function Modes

2.7. Deleting stored data - Mode 34

1. Press MODE [3] [4] keys in succession.

2. Confirm input with ENTER.

Cancel all Data ? "↵ " then appears in the display.

3. Press ENTER.

YES = "0" NO = "↵ " is also displayed.

4. Press ENTER, to retain data in memory.
The display then reverts to working mode.

5. Press [0] to delete data.

Cancelled then appears briefly in the display, which then reverts to working mode.

2. Function Modes

2.8. Laboratory operation (Professional Mode) - Mode 50

In principle, the photometer takes into account the following information:

1. Method (e.g. chlorine)
2. Measurement range
3. Date and time
4. Sequential number
5. Code number
6. Differentiation of measurement results (e.g. free, combined, total chlorine)
7. Detailed operator guide
8. Compliance with colour reaction times (timer-function)

The Mode 50-function allows the photometer to be limited to give minimum operator guidance. The above criteria are not then taken into account in the analyses, apart from method of measurement range.

1. Switch unit on by pressing the ON/OFF button.

2. After "Autotest" has cleared press MODE [5] [0] keys in succession.

3. Confirm input with ENTER.

Profi Mode

on = 1 off = 0

then appears in the display.

Press key [0], if you wish the unit to be in working mode, which takes into account comprehensive data records, (see points 1 – 8 above).

Press key [1], if you wish the unit only to take into account the limited data records, (see points 1 and 2 above).

2. Function Modes

***** Lovibond *****
Photometer PC 22
Select method:
Number or "↑↓ "

After selecting professional mode in section 2.8. the following message appears in the display:

4. Select the required method, e.g. aluminium is selected with SCROLL or entering the method number, [10]. Confirm with ENTER.

Al Test
0.01 – 0.3 mg/l
"Zero" ?

then appears in the display.

5. To zero, fill a cell to the 10 ml mark with water sample and place it in the cell compartment. Close the lid and press the ZERO key.

Zero ok "Test" ?

then appears in the display.

6. Remove the cell from the cell compartment, then add the relevant reagent tablet(s). Crush and mix to dissolve. Wait the specified time for colour development to be complete (in this case exactly 10 minutes) and **only then** press the TEST key.

Al 0.14 mg/l

The result then appears in the display, e.g.:

This display continues until a further key is pressed.

The choices are:

1. Carry out further tests in the same test parameter. If the same cell is used, after thorough cleaning, it is not necessary to reset zero. If a different cell is used it is essential to reset the zero before carrying out the test.
2. Choose another test parameter by pressing the relevant keys or using the SCROLL keys. In this case it is essential to reset zero in all cases.
3. If no further measurements are required, switch off by pressing the ON/OFF button.

2. Function Modes

Further Testing Without Resetting zero

If the TEST key is pressed after measurement without previous resetting of zero.

Same sample ? then appears in the display.

Pressing the TEST key **again**. The unit will then carry out a further measurement using the zero calibration stored in memory, but only if the method has not been changed.

Zero ok "Test" ?

This is displayed if the zero adjustment has been retained satisfactorily:

Prepare the test solution in the original cleaned cell. Allow the relevant test time where necessary. Place the cell in the cell compartment and press TEST key. The instrument will carry out the test measurement and display the result as previously.

Notes

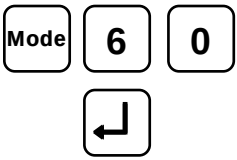
The measurement values determined cannot be stored and printed later when in the "Mode 50 Function".

If a different procedure from the given methods is followed in preparing and analysing the samples, e.g. non-compliance with the colour reaction times etc., major errors may occur in results.

2. Function Modes

2.9. Polynomials - Mode 60

(see also Page 129)



1. Press MODE [6] [0] keys in succession.

2. Confirm input with ENTER.

Poly. ? "1, 2, 3" ? then appears in the display.

3. Select required Polynomials number by pressing the relevant key e.g. press [1] to select Polynomial 1.

4. Confirm with ENTER.

Poly.1
A = + -. - - - - - - - E + - -
B = + -. - - - - - - - E + - -
C = + -. - - - - - - - E + - -

5. If Polynomial 1 has already been defined by previous use, the polynomials coefficients are displayed and the programme can be left by pressing ENTER.

Poly.1
A = + -. - - - - - - - E + '

In this case if any other key is pressed, the old values will be overwritten. Otherwise the display reads:

6. Enter the polynomials coefficients only in the specified format:

   A = + - . - - - - - - -E + - - ie.

   9 numbers must be inserted (use [0] if necessary)

   The [+] symbol can be changed to a [–] symbol with the SCROLL UP key.

2. Function Modes

7. After entering coefficient A, confirm with ENTER.

8. Proceed in the same manner for coefficients B and C.

9. After coefficients A, B and C have been entered the display shows:

LED = ?	
470 = 1	**528 = 2**
580 = 3	**650 = 4**
660 = 5	

Enter the corresponding LED, for which the polynomials was prepared, e.g. [1] for a measurement of 470 nm. Remember to make a note of the chosen wavelength and analysis for which this is intended.

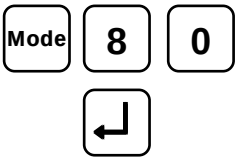
10. Confirm input with ENTER.

Stored then appears briefly in the display.

Polynomial 1 is now stored.
Polynomial 1 can be called up with method number 800.
Polynomial 2 has method number 810.
Polynomial 3 has method number 820.

2. Function Modes

2.10. Display contrast - Mode 80



1. Press MODE [8] [0] keys in succession.

2. Confirm input with ENTER.

LCD "↑↓ " then appears in the display.

Press SCROLL UP key to increase contrast of LCD display.

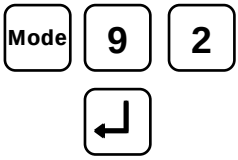
Press SCROLL DOWN key to reduce contrast of LCD display.

3. Confirm with ENTER.

2. Function Modes

2.11. Self diagnosis (Autotest) - Mode 92

In addition to the self-test cycle when the instrument is switched on and after every 200 measurements, the Autotest can be carried out at any time the instrument is being used to check the windows in the cell compartment are clean etc., by selecting this mode.



1. Press MODE [9] [2] keys in succession.

2. Confirm input with ENTER.

Autotest
Clear chamber ?
Yes : Press Test

then appears in the display.

3. Check the cell compartment is empty, close the photometer lid and press TEST key.

Test ■ . . . . . .

appears in the display 5 times in succession followed by:

Photometer ok.

This indicates the photometer lens is ok. The unit then reverts automatically to measuring mode.

or

Chamber windows dirty
Please clean
Clean ? Yes = T

The windows in the cell compartment should then be cleaned with a cotton wool bud moistened with alcohol or water and then dried with a clean dry cotton wool bud.

2. Function Modes

When this has been done press the TEST key.

Test ■ . . . . . .

appears in the display 5 times in succession followed by:

Photometer ok.

This indicates the photometer lens is ok and the and the unit reverts automatically to measuring mode.

or

Call Service

This indicates that the windows have not been completely cleaned or there is some other fault. To clear this sign, switch the instrument off. Further cleaning and testing may be carried out but it is strongly recommended that the unit should be returned to the supplier for service.

3. Initial Operation

3.1. **Working mode** (see 2.8. - Mode 50)

Before switching on the Photometer, ensure that the cell compartment is empty and the photometer lid is closed, as the Photometer **always** starts with self test.

1. Switch unit on with ON/OFF button.

Autotest
*** * * LOVIBOND * * ***
Photometer PC 22
Select method :
No. or "↑↓ "

appears in the display followed by:

2. The method is selected by pressing **either** the SCROLL (UP or DOWN) key until the required method is displayed e.g. for iron:

Fe 040

or the method number is entered directly, (see page 9 and 10) by pressing e.g. [0] [4] [0].

3. Then press ENTER.

The following message is displayed:

Fe Test
0.01 - 1 mg/l
Test No. : * * *
Code No. :

3. Initial Operation

Test Number:

The sequential test number appears automatically.

- It only takes into account stored data records
- Counts incrementally, to 3 figures
- Reset to zero when the stored memory is deleted (see Mode 34)

Code Number:

The operator can enter up to a 6 figures code in the "Code No." line.

Examples for use of code No. are to allow for:

- Reference numbers for different operators
- Reference numbers for specific sites
- Greater selection of print-out options.

After entering the code number, press ENTER.

If no code number is required, the ENTER key can be pressed straight away.

3.2. Zero calibration

Prepare Zero &

"Press Zero"

then appears in the display followed by:

Fill a clean cell up to the 10 ml mark with the water sample. Place the cell in the cell compartment with the graduations facing to the front and then close the lid.

Press ZERO key.

Zero ok !

Prepare Test

Start Test

then appears in the display.

3.3. Analysis

When zero calibration is completed, remove the cell from the cell compartment and then follow the relevant test procedure for the analysis as given in section 5 e.g. for iron see 5.21. (page 87).

3.4. Post test options

After the test result is displayed it is then possible to:

- Store and / or print the result
- Carry out further tests for the same parameter
- Select another test parameter

Storing the Test Result

Inmediately after the result is displayed press the STORE key. The complete data record is stored in the memory, with date, time, test number, code number, method and test result.

Stored

This is displayed briefly before the test result is again displayed.

Printing the Test Result

Provided the printer is connected correctly and switched on, the result may be printed out withou need for storage by pressing the PRINT key. The complete test record is printed including date, time, test number, method and test result.

Carrying out further Tests

If further tests using the same test method are required these may be done without needing to check the zero calibration, by pressing the TEST key.

Same Sample ?

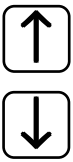
then appears in the display.

Press the TEST key again.

Same Sample ?

This message is displayed for most test methods, exceptions being those where the technique allows separation into fractions e.g. chlorine, chlorine dioxide methods etc., when the display gives instruccions as indicated in the individual methods (see 5.5., 5.7. etc.)

It is essential that the tube used for the original zero calibration is used for such subsequent tests, but only after thorough cleaning.



If a different test method is required, select the required method using the SCROLL or entering the relevant number. It is essential to carry out a Zero calibration when a different method is selected.

3.5. Operator error

Input Error

1. During certain operations, if the wrong key is pressed this message is displayed:
2. The unit then reverts to the previous display.

3.6. Self diagnosis (Autotest)

Self diagnosis is carried out automatically by the photometer after switching on, and also after every 200 measurements. "Autotest" checks that the windows protecting the light source and photosensor are clean. If one or both are dirty, major errors are likely in test results.

The cell compartment should be cleaned, paying particular attention to the windows (for further informations see Mode 92, page 31).

3.7. Display time and date

1. Press CLOCK key.

04.02.1996 12:34

The following is then displayed briefly, for example:

2. The unit then reverts automatically to the previous display.

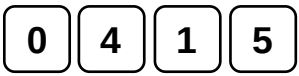
3. Initial Operations

3.8. Countdown function

1. With the instrument switched on, press CLOCK key twice in immediate succession.

Count-Down
MM : SS

then appears in the display.



2. Enter required wait time in minutes and seconds. Example: 4 minutes 15 secondes = 04 15

3. Press ENTER.

Count-Down 04 : 15
Start "↵"

then appears in the display followed by:

4. Press ENTER again and the countdown function will start. The time remaining is displayed continuously. There is an acoustic signal in the last 10 seconds before the chosen time has elapsed.
5. The unit then reverts automatically to the previous display.

Note

The countdown function is blocked during other functions, such as zero calibration or analysis.

3. Initial Operations

3.9. Charging the battery

The battery is charged in the unit. It remains in the battery compartment and is connected in the same way as for standard operation. As soon as a plug-in power supply with the required properties is connected, the battery is charged, regardless of whether the unit is on or off or whether test are being performed.

The charging current is limited to a maximum value of 11 mA, and is mostly between 8 and 9 mA. The charging voltage - measured in no-load status, in other words without storage battery - is regulated to approx. 10,5 V, but it is slightly dependent on the ambient temperature.

An empty battery should be charged in the unit for approx. 20 hours. Longer charging of the storage battery has no adverse effect but can lead to a "memory effect" which reduces the capacity. Repeated full charging of an only partly empty storage battery can also lead to this "memory effect".

If possible, the battery should therefore be used until the "Low-Bat" indicator lights up and then charged in the unit for approx. 20 hours.

4. Important Notes

Operator Message	Possible Cause
Zero-Error < < <	Too little light on photocell. Cause may be due to dirty windows in cell compartment.
Zero-Error > > >	Too much light on photocell. Cause may be due to excess light e.g. if the cell compartment lid has been left open.
fr Cl 0.60 mg/l **com Cl ERROR** **tot Cl 0.59 mg/l**	This type of error only occurs in methods involving separation of a sample e.g. Chlorine separated into Free, Combined and Total Chlorine as in this example. The readings for Free and Total Chlorine are within the accepted tolerances of the instrument. The combined Chlorine reading is 0 mg/l. Differences outside the accepted tolerance can, for example, be caused by undissolved particles of the test tablet in the water sample. In this event, the test must be repeated ensuring the correct sample preparation technique is observed.
Test-Error >>> or **Cys + + + mg/l**	Measurement range exceeded or water sample too cloudy. (+ + + mg/l) indicates that the result is above the top limit of the range.
Test-Error <<< or **Cys - - - mg/l**	(– – – mg/l) indicates that the result is below the bottom limit of the range. These symbols can be stored or printed out if necessary. Error due to excess light e.g. due to the lid being opened or due to optical density of light beam e.g. in pH mode the solution colour is not measurable due to the pH being below the lower limit of the range. Error due to excessive average value fluctuations when carrying out Zero calibration or a test measurement. The cause may be undissolved tablet particles or suspended matter in water sample.
Low-Bat **Replace/charge**	The standard 9V rechargeable battery should be charged by means of the charging jack on the back of the photometer using the mains charging equipment. The charging time is about 20 hours. The photometer has integral overload protection.
TEMP-DRIFT **Please wait** **Close cover**	The temperature difference between the photometer and the environment is too great. The cell compartment must be closed whilst the temperatures are equalizing.

4. Important Notes

Unit ok **Press Key**	Is displayed when the unit is ready for use, as soon as the temperature has been balanced by acclimatization.
Temp. Difference	If measurement is carried out after temperature balancing without Zero resetting, the following request is displayed:
Repeat zero	This message may also appear if the last Zero value was made with a unit temperature differing substantially from the current unit temperature.
*** Al x,xx ppm***	The result is displayed between asterisks if there is a temperature drift during the measurement process (e.g. during the colour development time), which is largely compensated by the processor. The asterisks denote possible error in the results due to temperature drift.
Error x ON/OFF	This denotes an internal error. It is advisable to switch the unit off and then on again. If the error recurs, call in the Service. The same applies to all otherwise following error messages. State exact error message when returning the unit for service (e.g. Error 14 ON/OFF).
Error 01 ON/OFF	Appreciably more light on photodetector in TEST measurement than in ZERO measurement.
Error 02 ON/OFF	This error can occur if the photometer lid is opened during Autotest.
Error 03 ON/OFF	This error may occur on initialisation (or change of software), if ZERO or TEST are pressed without previously selecting a method.
Error 04 ON/OFF	This error message indicates that an unknown error has occurred in ZERO measurement. Check unit and repeat.
Error 05 ON/OFF	This error message indicates an unknown error. Check unit and repeat.
Error 06 ON/OFF	This error message can occur on initialisation or when the **internal** battery is flat. All data stored in memory will be lost. When this battery is replaced the unit is ready for use when ENTER is pressed.

4. Important Notes

4.2. Avoiding errors in photometric measurement

Note

For most error signals, the error signal is removed when the photometer is switched off.

1. Cells, stoppers and stirring rods should be cleaned thoroughly **after each analysis** to prevent errors being carried over. Even minor reagent residues can cause significant errors. Use the brush provided for cleaning.
2. The outside of the cell must be clean and dry before starting the analysis. Fingerprints or droplets of water on the outside of the cell, especially the light penetrating surfaces can lead to test errors.
3. Zero calibration and Test must be carried out with the same cell as there may be slight differences in optical properties between cells.
4. The cells must be positioned in the cell compartment for Zero calibration and Test with the graduations facing toward the operator.
5. Zero calibration and Test must be carried out with the cell compartment lid closed.
6. Bubbles on the inside of the cell can also lead to test errors. In this case, fit the cell with a clean stopper and remove bubbles by swirling the contents before starting to Test.
7. Avoid spillage of water in the cell compartment. If water should leak into the photometer housing, it can damage electronic components and cause corrosion.
8. As stated in Autotest (see Mode 92), dirt on the windows covering the light source and detector in the cell compartment can lead to test errors. These windows should be checked at regular intervals and cleaned as necessary. Use a cotton bud for cleaning.
9. Use only reagent tablets in black printed foil. For pH value determination, the PHENOL-RED-tablet foil should also be marked Photometer.
10. The reagent tablets should be added to the water sample without being handled.
11. Major temperature variations between the Photometer and the ambient temperature may generate errors, e.g. due to condensation forming on the windows.
12. If you intend to print out the test results immediately after the test, make sure the printer is attached to the photometer. Switch on the printer first and then the Photometer.

5. Methods

0 0 5

5.1. **Alkalinity-m** (Enter 005)

Zero ok !

1. After Zero calibration the following is displayed:

Prepare Test

Start Test

2. Remove the cell from the cell compartment.
3. Add an ALKA-M-PHOTOMETER-tablet, crush and mix well with a clean stirring rod.
4. Fit the cell with a clean stopper. Ensure the tablet has dissolved completely.
5. Place the cell in the cell compartment and close the lid.

Test

6. Press TEST key.

Test ■ . . . . . .

then appears in the display.

Date Time

Alk * mg/l $CaCO_3$**

The result is in mg/l $CaCO_3$.

Print

7. If you require to print out the result inmediatetly after the test, make sure the printer has been connected and switched on before the test is started. Press PRINT after the test result has been displayed.

Store

If you wish to store the result, press STORE.

5. Methods

Notes

1. The terms total alkalinity, alkalinity-m, m-value and the alkalinity to pH 4.3 are identical.
2. For accurate results exactly 10 ml of sample must be taken for the test.
3. The detection limit (lowest concentration to be determined) is 5 mg/l $CaCO_3$.

Conversion Table

	Alkaline Earth Ions mmol/l	Alkaline Earth Ions m.equiv/l	ppm $CaCO_3$	German Deg. °d	English Deg. °e	French Deg. °f
1 mg/l $CaCO_3$	0.01	0.020	1.00	0.056	0.07	0.10

5. Methods

0 0 6

5.2. **Alkalinity-p** (Enter 006)

Zero ok !

1. After Zero calibration, the following is displayed:

Prepare Test

Start Test

2. Remove the cell from the cell compartment.
3. Add an ALKA-P-PHOTOMETER-tablet, crush and mix well with a clean stirring rod. Ensure all particles are dissolved.
4. Fit the cell with a clean stopper.
5. Place the cell in the cell compartment and close the lid.

Test

6. Press TEST key.

Test ■ . . . . . .

then appears in the display.

Date Time

The result is in mg/l $CaCO_3$.

Alk * mg/l $CaCO_3$**

7. Press PRINT, STORE or select another test parameter as necessary.

5. Methods

Notes

1. The terms p-alkalinity, p-value and the alkalinity to pH 8.3 are identical.
2. In order to obtain accurate test results it is important that the volume of sample taken is exactly 10 ml.

Conversion Factors

	Alkaline Earth Ions mmol/l	Alkaline Earth Ions m.equiv/l	ppm $CaCO_3$	German Deg. °d	English Deg. °e	French Deg. °f
1 mg/l $CaCO_3$	0.01	0.020	1.00	0.056	0.07	0.100

By determining both the p- and m-alkalinity it is possible to classify the alkalinity as hydroxide, carbonate and hydrogen carbonate. The following differentiation is only valid if:

1. no other alkalis are present and
2. Hydroxide and hydrogen carbonate are not present in the same (lit. 2).

If condition 2) is not fulfilled please get additional information from Lit. 1, Kapitel D8.

Hence we have:

1. If the p-alkalinity = 0
   Hydrogen carbonate = m
   Carbonate = 0
   Hydroxide = 0
2. If the p-alkalinity > 0 and the m-alkalinity > 2p
   Hydrogen carbonate = m - 2p
   Carbonate = 2p
   Hydroxide = 0
3. If the p-alkalinity > 0 and the m-alkalinity < 2p
   Hydrogen carbonate = 0
   Carbonate = 2m - 2p
   Hydroxide = 2p - m

Accuracy of the method

The present method was developed from a titration procedure. Due to undefined boundary conditions the deviations from standardised methods may be greater.
The detection limit (smallest concentration measured) is about 5 mg/l $CaCO_3$.

5. Methods

0 1 0

5.3. **Aluminium** (Enter 010)

Zero ok !

Prepare Test

Start Test

1. After Zero calibration the following is displayed:

2. Remove the cell from the cell compartment.

3. Add an ALUMINIUM No. 1-tablet to the 10 ml water sample, crush and mix carefully with a clean stirring rod.

4. Add an AlLUMINIUM No. 2-tablet to the same sample, crush and mix **gently** with the same stirring rod.

5. Fit a stopper to the cell and ensure the tablets have dissolved completely.

6. Place cell immediately in the cell compartment, close the lid and press TEST key.

Test

10:00 Delay

is displayed indicating the time allowed for full colour development.

The time remaining is displayed continuously starting from 10 minutes. During this time, check at intervals that the solution is still bubble free and mix again if necessary. The beeper is actuated during the last 10 seconds before the full time has elapsed.

Test ■ . . . . . .

then appears in the display.

The test is then carried out automatically and the result displayed in mg/l Al:

Date Time

Al * mg/l**

7. Press PRINT, STORE or select another test parameter as required.

5. Methods

Notes

1. The tablets must be added in the correct sequence.
2. Interference by Iron and manganese is prevented by a special tablet ingredient.
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)	Aluminium (mg/l Al)					
	0.05	0.11	0.16	0.21	0.27	0.32
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	–

5. Methods

0 **1** **5**

5.4. **Ammonia** (Enter 015)

Zero ok !

Prepare Test

Start Test

1. After Zero calibration the following is displayed:

2. Remove the cell from the cell compartment. Ensure the temperature of the sample is at least 20 °C.

3. Add an AMMONIA No. 1-tablet to the 10 ml water sample, crush and mix carefully with a clean stirring rod.

4. Add an AMMONIA No. 2-tablet to the same sample, crush and mix well with the same stirring rod.

5. Ensure the tablets have completely dissolved and fit a clean stopper to the cell.

Test

6. Place cell in the cell compartment, close the lid and press TEST key.

10:00 Delay

is displayed briefly indicating the time allowed for full colour development.

The time remaining is displayed continuously starting from 10 minutes. The beeper sound during the last 10 seconds before the full time has elapsed.

Test ■ . . . . . .

then appears in the display.

The test is then carried out automatically and the result displayed in mg/l as N:

Date Time

NH_4 * mg/l N**

7. Press PRINT, STORE or select another test parameter as required.

5. Methods

Notes

1. The tablets must be added in the correct sequence.
2. The AMMONIA No. 1-tablet will only dissolve completely after the AMMONIA No. 2-tablet has been added.
3. The temperature of the sample is important for full colour development.

Conversion Factors

The factors to convert the test result (as N) to NH_3 or NH_4 are:

$NH_3 = N \times 1.22$
$NH_4 = N \times 1.29$

5. Methods

0 1 9

5.5. **Boron** (Enter 019)

Zero ok !

Prepare Test

Start Test

1. After Zero calibration the following is displayed:

2. Remove the cell from the cell compartment.
3. Add a BORON No. 1-tablet, crush and mix well with a clean stirring rod.
4. Add a BORON No. 2-tablet to the same sample, crush and mix well with the same stirring rod. Ensure all particles are dissolved.
5. Fit the cell with a clean stopper.
6. Place cell in the cell compartment and close the lid.

Test

7. Press TEST key.

10:00 Delay

is displayed briefly.

This indicates the time required for full colour development. The time remaining is displayed continuously starting from 10 minutes. The beeper sounds for the last 10 seconds of this time.

Test ■ . . . . . .

then appears in the display.

The test is then carried out automatically and the result displayed in mg/l B:

Date Time

B * mg/l**

7. Press PRINT, STORE or select another test parameter as necessary.

5. Methods

Notes

1. The tablets must be added in the correct order.
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 colour development depends on the temperature. The temperature of the sample must be 20 ±1 °C; a water bath should be used where appropriate.

5. Methods

0 2 0

5.6. **Bromine** (Enter 020)

Zero ok !

Prepare Test

Start Test

1. After Zero calibration the following is displayed:

2. Remove the cell from the cell compartment and empty except for a few drops of the water sample.
3. Add a DPD No.1-tablet and crush with a clean stirring rod.
4. Fill cell to the 10 ml mark with the sample. Mix well with the stirring rod, making sure the tablet has dissolved completely and that there are no bubbles present.
5. Fit a clean stopper to the cell. Make sure the outside of the cell is clean and dry. Place the cell in the cell compartment and close the lid.

Test

6. Press TEST key.

Test ■ . . . . . .

then appears in the display.

Date Time

Br * mg/l**

The result is then displayed in mg/l bromine.

7. Press PRINT, STORE or select another test parameter as required.

5. Methods

Notes

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. The DPD colour development is carried out with a pH value adjustment.

Strongly alkaline or acidic water must, however, be neutralized before the analysis.

Concentrations above 20 mg/l of bromine can produce results within the measuring range up to 0 mg/l. In this event, the water sample muts be diluted and the measurement repeated.

The result displayed is active bromine. If differentiation into free and combined bromine is required refer to supplier.

5. Methods

0 3 1

5.7. Chloride (Enter 031)

Zero ok !

Prepare Test

Start Test

1. After Zero calibration the following is displayed:

2. Remove the cell from the cell compartment. Make sure that the sample temperature is between 20 °C and 30 °C.

3. Add a CHLORIDE T1-tablet, crush and mix well with a clean stirring rod. Ensure all particles are dissolved.

4. Add a CHLORIDE T2-tablet to the same sample and use a clean stirring rod to dissolve the tablet by gentle mixing. Ensure all particles are dissolved. Avoid any vigorous mixing with aeration, because this would cause larger particles which floc together, resulting in a clearer solution and lower results.

5. Fit the cell with a clean stopper. Place the cell in the cell compartment and close the lid.

Test

6. Press the TEST key.

02:00 Delay

is displayed briefly.

This indicates the reaction time. The time remaining is displayed continuously starting from 2 minutes. The beeper sounds for the last 10 seconds of this time.

Test ■ . . . . . .

then appears in the display.

The test is then carried out automatically and the result displayed in mg/l Cl:

Date Time

Cl * mg/l**

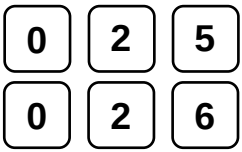
7. Press PRINT, STORE or select another test parameter as necessary.

5. Methods

Notes

1. Higher concentration of electrolytes and organic compounds have different effects on the precipitation reaction. In such cases it is advisable first to separate the chloride by means of a combination precipitation using silver chloride and barium sulfate.
   [Chem. Anal. (Warsaw), 1963, 8, 517].
2. Ions which also form precipitates with silver nitrate in acid media, such as bromide, iodide and thiocyanate, will interfere.
3. Strongly alkaline waters should be neutralized with nitric acidic before the reaction is carried out with the reagent tablet.

5. Methods



5.8. Chlorine (Enter 025 or 026)

Zero ok !
Cl FRACTION = 1
Cl FREE = 2
Cl TOTAL = 3
Press 1, 2 or 3 !

1. After Zero calibration the following is displayed:

2. Press key [1] for determination of free, combined and total chlorine.

3. Press key [2] for determine free chlorine only.

4. Press key [3] to determine total chlorine only.

5. Methods

Determination of chlorine fractions
(free, combined, total)

1. Press key [1].

T1 prepare !
T1 start

then appears in the display.

2. Remove the cell from the cell compartment and empty except for a new drops of the water sample.
3. Add a DPD No.1-tablet and crush with a clean stirring rod.
4. Fill cell to the 10 ml mark with the sample, mix well with the stirring rod making sure the tablet has dissolved completely and that there are no bubbles present.
5. Fit a clean stopper to the cell. Make sure the outside of the cell is clean and dry.
6. Place the cell in the cell compartment and close the lid.

7. Press TEST key.

T1 Test ok !
T1 prepare !
T1 start

is displayed.

8. After determining the free chlorine, remove the cell from the cell compartment.

5. Methods

9. Add a DPD No. 3-tablet to the same sample and crush with the stirring rod and mix well.

10. Fit the stopper in the cell. Make sure that the outside of the cell is clean and dry.

11. Place cell in the cell compartment and close the lid.

12. Press TEST key.

02:00 Delay is displayed briefly.

This is the time necessary for complete colour development.

The time remaining is displayed continuously starting from 2 minutes. The beeper sounds for the last 10 seconds of this time and then the test is carried out automatically.

Test ■ . . . . . . then appears in the display.

Date Time The differentiated result is then displayed:

fr Cl * mg/l** mg/l free chlorine

com Cl * mg/l** mg/l combined chlorine

tot Cl * mg/l** mg/l total chlorine

(If ERROR is displayed see page 39)

13. Press PRINT, STORE or select another test parameter as necessary.

5. Methods

Free chlorine only

1. Press key [2].

Prepare Test

Start Test

then appears in the display.

2. Remove the cell from the cell compartment and empty except for a new drops of the water sample.
3. Add a DPD No. 1-tablet and crush with a clean stirring rod.
4. Fill cell to the 10 ml mark with the sample, mix well with the stirring rod making sure the tablet has dissolved completely and that there are no bubbles present. Fit a clean stopper.
5. Place the cell in the cell compartment and close the lid.

6. Press TEST key.

Test ■ . . . . . .

then appears in the display:

Date Time

fr Cl * mg/l**

The result is then displayed in mg/l free chlorine:

7. Press PRINT, STORE or select another parameter as required.

5. Methods

Total chlorine

1. Press key [3].

Prepare Test

Start Test

then appears in the display.

2. Remove the cell from the cell compartment and empty except for a few drops of the water sample.
3. Add one DPD No. 1-tablet and one DPD No. 3-tablet and crush with a clean stirring rod.
4. Fill cell to the 10 ml mark with the sample. Mix well with the stirring rod to ensure the tablet dissolves completely and that there are no bubbles present. Fit a clean stopper.

5. Place the cell in the cell compartment, close the lid and press TEST key.

02:00 Delay

is displayed briefly, indicating the time allowed for full colour development.

The time remaining is displayed continuously starting from 2 minutes. The beeper sounds during the last 10 seconds before the full time has elapsed.

Test ■ . . . . . .

then appears in the display.

The test is then carried out automatically and the result is displayed in mg/l total chlorine:

Date Time

tot Cl * mg/l**

6. Press PRINT, STORE or select another parameter as required.

5. Methods

Notes

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.

The DPD colour development requires a pH of 6.3 – 6.5 . The reagent tablets therefore contain a buffer for pH adjustment.

Strongly alkaline or acidic water must, however, be neutralized before the analysis.

Concentrations above 10 mg/l of chlorine can produce results within the mesauring range up to 0 mg/l. In this event, the water sample must be diluted and the measurement repeated.

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. In this event, the reagent tablet DPD No. 1 HIGH CAL should be used as an alternative. Even if the turbidity does not occur until after the DPD No. 3-tablet has been added, this can be prevented by using the DPD No. 1 HIGH CAL-tablet.

5. Methods

0 2 7

5.9. Chlorine HR (KI) (Enter 027)

Zero ok !

Prepare Test

Start Test

1. After Zero calibration the following is displayed:

2. Remove cell from the cell compartment. Add an ACIDIFYING GP-tablet to the 10 ml water sample and crush with a clean stirring rod.

3. Add a CHLORINE HR (Potassium Iodide)-tablet to the same sample and crush and mix well with the stirring rod. Fit a clean stopper to the cell.

Test

4. Place the cell in the cell compartment, close the lid and press TEST key.

Test ■ . . . . . .

then appears in the display.

Date Time

Cl (HR) * mg/l**

The result is then displayed in mg/l total chlorine:

5. Press PRINT, STORE or select another test parameter as necessary.

5. Methods

0 3 0

5.10. Chlorine dioxide (Enter 030)

Zero ok !

ClO_2 / Cl = 1

ClO_2 = 2

Press 1 or 2

1. After Zero calibration the following is displayed:

1

2. Press key [1] to determine chlorine dioxide in the presence of chlorine.

2

3. Press key [2] to determine chlorine dioxide in the absence of chlorine.

Chlorine dioxide / chlorine

1

1. Press key [1].

T1 Prepare

T1 Start

then appears in the display.

2. Remove the cell from the cell compartment and empty except for a few drops of the water sample.
3. Add a DPD No. 1-tablet and crush with a clean stirring rod.
4. Fill a second cell to the 10 ml mark with the sample.

   Add a GLYCINE-tablet, crush and mix well with a clean stirring rod.

5. Methods

5. Add contents of second cell to first cell. Mix well with the stirring rod and fit a clean stopper to the cell. Make sure the outside of the cell is clean and dry.

6. Place the cell in the cell compartment and close the lid.

Test

7. Press TEST key.

T1 Test ok !

T2 prepare !

T2 start

is displayed.

8. Remove the cell from the cell compartment, clean thoroughly and add a few drops of the water sample.

9. Add a DPD No. 1-tablet and crush with a clean stirring rod.

10. Fill cell to the 10 ml mark with the sample and mix well with the stirring rod. Fit a clean stopper. Make sure the outside of the cell is clean and dry.

11. Place the cell in the cell compartment and close the lid.

Test

12. Press TEST key.

T2 Test ok !

T3 prepare !

T3 start

is displayed.

13. Remove cell from the cell compartment. Add a DPD No. 3-tablet to the same sample and crush and mix well with the stirring rod. Fit a clean stopper to the cell. Make sure the outside of the cell is clean and dry.

5. Methods

Test

14. Place the cell in the cell compartment, close the lid and press TEST key.

02:00 Delay

is displayed briefly.

This indicates the time required for full colour development.

The time remaining is displayed continuously starting from 2 minutes. The beeper sounds for the last 10 seconds of this time and then the test starts automatically.

Test ■ . . . . . .

then appears in the display.

Date Time

The result is then displayed:

ClO_2 * mg/l**

Chlorine dioxide in mg/l as chlorine (see first Note)

free Cl * mg/l**

mg/l free chlorine

com Cl * mg/l**

mg/l combined chlorine

tot Cl * mg/l**

mg/l total chlorine

15. Press PRINT, STORE or select another test parameter as necessary.

Notes

The conversion factor to convert chlorine dioxide as chlorine to chlorine dioxide as ClO_2 is approximately 0.4 (more exactly 0.38).

The total chlorine result given includes the contribution by the chlorine dioxide. For true total chlorine reading subtract the ClO_2 reading from the quoted total chlorine reading.

5. Methods

Chlorine dioxide

1. Press key [2].

Prepare Test

Start Test

then appears in the display.

2. Remove the cell from the cell compartment and empty except for a few drops of the water sample.
3. Add a DPD No.1-tablet, crush and mix well with a clean stirring rod.
4. Fill the cell to the 10 ml mark with the sample, mix well. Fit the cell with a clean stopper. Make sure there are no bubbles in the solution and that the outside of the cell is clean and dry.
5. Place the cell in the cell compartment and close the lid.

6. Press TEST key.

Test ■ . . . . . .

then appears in the display.

Date Time

The result is displayed:

ClO_2 = * mg/l Cl**

Chlorine dioxide as chlorine

= * mg/l ClO_2**

Chlorine dioxide as ClO_2

7. Press PRINT, STORE or select another test parameter as necessary.

5. Methods

Notes

1. The analysis must be carried out immediately after taking the sample.
2. For full DPD colour development a pH value of 6.3 – 6.5 is required. The reagent tablets therefore contain a buffer for pH adjustment. Strongly alkaline or acidic water should, however, be neutralized before the analysis.
3. Bleaching of the DPD by high levels of chlorine and/or chlorine dioxide can produce results within the measurement range. The presence of such higher levels are indicated, when the tablet is crushed initially, if a deep red colour is given which decreases when the water sample is added. Should this occur, dilute the sample and retest this, multiplying the test result by the dilution factor.

5. Methods

0 6 5

5.11. Copper LR (Enter 065)

Zero ok !

Prepare Test

Start Test

1. After Zero calibration the following is displayed:

2. Remove the cell from the cell compartment.

3. Add a COPPER / ZINC LR-tablet, crush and mix well with a clean stirring rod. Ensure all particles are dissolved. Fit the cell with a clean stopper.

Test

4. Place the cell in the cell compartment and close the lid and press the TEST key.

05:00 Delay

is displayed briefly.

This indicates the time required for complete colour development.

The time remaining is displayed continuously starting from 5 minutes. The beeper sounds for the last 10 seconds of this time and the test is then carried out automatically.

Test ■ . . . . . .

then appears in the display.

Date Time

Cu * mg/l**

The result is displayed in mg/l free copper.

5. Press PRINT, STORE or select another test parameter as necessary.

5. Methods

Notes

The presence of zinc will give high readings as it reacts with the indicator in the same way as copper does. To correct for this, after the reading has been given in 5 above, note the result. Remove the cell from the cell compartment. Add one EDTA tablet. Crush and mix to dissolve. This removes that part of the colour due to the zinc. Return the cell to the cell compartment and close the lid.

1. Press MODE [1] [3] in succession then ENTER.

Delay Auto
YES = 1 NO = 2

then appears in the display.

2. Press [2] then TEST.

Same sample?

is displayed.

3. Press TEST **twice**.

Date Time
Cu *, mg/l**

The result is displayed in mg/l free copper.

Note this result.

The difference between this result and the previous one is the zinc concentration in the sample.

5. Methods

Some bleaching of the colours may be observed in this test, due to:

a) high levels of copper or
b) high levels of residual chlorine.

If a) is suspected, dilute the sample with copper-free (e.g. deionised) water and repeat the test, multiplying the result by the dilution factor.

If b) is the case, repeat the test on a water sample after dechlorination. To dechlorinate the sample, after zero calibration first add a DECHLOR-tablet. Crush and mix to dissolve. Then add the COPPER / ZINC LR-tablet and continue with test procedure from 3) above.

5. Methods

5.12. Copper / free and total (Enter 070)

Zero ok !
Cu Fraction = 1
Cu Free = 2
Cu Total = 3
Press 1, 2 or 3

1. After Zero calibration the following is displayed:

2. Press key [1] for the differentiated determination of free, complexed and total copper.

3. Press key [2] for the determination of free copper.

4. Press key [3] for the determination of total copper.

Determination of copper fractions
(free, complexed, total)

1. Press key [1].

T1 prepare !
T2 start

then appears in the display.

2. Remove the cell from the cell compartment.
3. Add a COPPER No.1-tablet, crush and mix well with a clean stirring rod. Fit the cell with a clean stopper.

5. Methods

4. Place the cell in the cell compartment and close the lid.

5. Press TEST key.

T1 Test ok !
T2 prepare!
T2 start

then appears in the display.

6. Remove the cell from the cell compartment.
7. Add a COPPER No. 2-tablet to the same sample. Crush and mix well with a clean stirring rod. Fit the cell with a stopper.
8. Place the cell in the cell compartment and close the lid.

9. Press TEST key.

Test ■ . . . . . .

then appears in the display.

Date Time

The result is then displayed:

fr Cu * mg/l**

mg/l free copper

com Cu * mg/l**

mg/l complexed copper

tot Cu * mg/l**

mg/l total copper

10. Press PRINT, STORE or select another parameter as necessary.

5. Methods

Free Copper

1. Press key [2].

Prepare Test
Start Test

then appears in the display.

2. Remove the cell from the cell compartment.
3. Add a COPPER No. 1-tablet, crush and mix well with a clean stirring rod. Fit cell with a clean stopper.
4. Place the cell in the cell compartment and close the lid.

5. Press TEST key.

Test ■ . . . . . .

then appears in the display.

Date Time
fr Cu * mg/l**

The result is displayed in mg/l as free copper.

6. Press PRINT, STORE or select another parameter as necessary.

Total Copper

The test procedure is as for free copper, except that in stage 3) both a COPPER No. 1- and a COPPER No. 2-tablet are added together, crushed and mixed.

The result displayed is then mg/l as total copper.

5. Methods

0 3 5

5.13. Cyanuric acid (Enter 035)

Zero ok !

Prepare Test

Start Test

1. After Zero calibration the following is displayed:

2. Remove the cell from the cell compartment.

3. Add a CYANURIC ACID-tablet to the 10 ml water sample, crush and mix well with a clean stirring rod. Fit cell with a clean stopper. If cyanuric acid is present a cloudy solution will be given.

4. Place the cell in the cell compartment and close the lid.

Test

5. Press TEST key.

Test ■ . . . . . .

then appears in the display.

Date Time

Cys * mg/l**

The result is displayed in mg/l cyanuric acid.

6. Press PRINT, STORE or select another test parameter as necessary.

5. Methods

	Note
Cys + + + mg/l	If after pressing the TEST key this is displayed, the cyanuric acid concentration is likely to be greater than 80 mg/l.
Test	Press the TEST key.
Same Sample ?	is displayed:
Test	Press TEST again.
Zero ok !	
Prepare Test	
Start Test	then appears in the display.
	Rinse out the test cell with the water sample and then fill the cell to the 5 ml mark (half full). Top up to the 10 ml mark with tap water and repeat the test procedure from 3 above. The result displayed should be doubled to correct for the dilution step.

5. Methods

0 4 5

5.14. Fluoride (Enter 045)

1. Carry out the zero operation using distilled water. After Zero calibration the following is displayed:

Zero ok !

T1 prepare!

T1 start

2. Remove cell from the cell compartment, empty it completely.
3. Mix 25 ml of distilled water (fluoride-free) with 5 ml of SPADNS mixed reagent in a suitable clean container (with a capacity of about 100 ml).
4. Transfer about 10 ml of this solution to the cell. Fit with a clean stopper.
5. Place the cell in the cell compartment and close the lid.

Test

6. Press TEST key.

T1 Test ok !

T2 prepare !

T2 start

is displayed.

7. Remove the cell from the cell compartment and return the contents to its original container. This should then contain 30 ml of diluted SPADNS reagent.
8. To this 30 ml of diluted SPADNS reagent add 25 ml of water sample to be tested. Mix well.
9. Fill the cell to the 10 ml mark with this mixture.
10. Place the cell in the cell compartment and close the lid.

Test

11. Press TEST key.

Test ■ . . . . . .

then appears in the display.

Date Time

The result is then displayed in mg/l F:

F * mg/l**

12. Press PRINT, STORE or select another test parameter as necessary.

5. Methods

Notes

1. If the sample contains chlorine, add 0.05 ml sodium arsenite solution (5 g/l) per 0.1 mg chlorine.
2. Concentrations of some substances which cause an 0.1 mg/l error at 1.0 mg/l fluoride.

	mg/l	Error
Alkalinity / $CaCO_3$	5000	–
Aluminium	0.1	–
Chloride	7000	+
Iron	10	–
Hexametaphosphate	1.0	+
Phosphate	16	+
Sulfate	200	–

[–] = Negative Error of 0.1 mg/l
[+] = Positive Error of 0.1 mg/l

5. Methods

0 4 9

5.15. Hardness / Calcium (Enter 049)

1. For zero calibration, the cell is filled with exactly 9 ml of deionised water (Ca ions free).

   After zero calibration, the following appears in the display:

Zero ok !

Prepare Test

Start Test

2. Remove the cell from measuring compartment.
3. Add a CALCHECK tablet direct from the foil and crush using a clean stirrer rod.
4. Seal the cell by attaching the cell cover and mix the contents by swirling until all the particles are completely dissolved.
5. Place the cell in the measuring compartmet and close the lid.

Test

6. Press the TEST key.

T1 Test ok !

T2 prepare!

T2 start

The following appears in the display:

7. Remove the cell from the measuring compartment and add exactly 1 ml of the water sample to be analysed.
8. Seal the cell by attaching the cell cover and mix the contents by swirling. Place the cell in the measuring compartment and close the lid.

Test

9. Press the TEST key..

5. Methods

Wait 2 minutes to permit the colour reaction.

02:00 Delay

The following appears in the display:

The remaining waiting time, based on the original 2 minutes, is displayed continuously. An acoustic signal is given during the last 10 seconds of the waiting time.

Test ■ . . . . . .

The following appears in the display:

Date Time

The display then shows the result in mg/l $CaCO_3$:

$CaCO_3$ (Ca) * mg/l**

10. Then press the key PRINT or STORE or set new test parameters.

Note

$CaCO_3$ (Ca) + + + mg/l

If the display shows :

It is likely that the calcium hardness level is greater than 100 mg/l. A dilution of the water sample is necessary. This may have to be 5 x, 10 x or 20 x and can be carried out using the 10 ml cell or 100 ml shaker tube with deionised water as diluent.

Press the TEST key.

Same Sample ?

is displayed.

The test is repeated as from 3. above.

5. Methods

Notes

1. Magnesium hardness up to 200 mg/l (as $CaCO_3$) does not interfere.
2. Iron concentrations greater than 10 mg/l produce lower values. Zinc concentration greater than 1 mg/l produce higher values.
3. Strongly acidic or strongly alkaline water should be adjusted to between pH4 and pH10 before testing.
4. The method has a greater tolerance at the high end of the test range than at the low end. When diluting samples, dilute so that measurement takes place in the bottom third of the range.

Conversion Table

mg/l $CaCO_3$ x 0.4 = mg/l Ca

	Alkaline Earth Ions mmol/l	Alkaline Earth Ions m.equiv/l	ppm $CaCO_3$	German Deg. °g	English Deg. °e	French Deg. °f
1 mg/l $CaCO_3$	0.01	0.02	1.00	0.056	0.07	0.10

Accuracy of method

This method was developed from a volumetric procedure for the determination of calcium. Due to undefined conditions, the deviations from the standardised method may be greater.

The detection limit (lowest concentration than can be determined) is 50 mg/l $CaCO_3$.

The relative standard deviation for spectrophotometric analyses with a wavelength of 575 nm is specified as 1.8 – 5.0 % (Lit 3).

5. Methods

0 5 0

5.16. Hardness / Calcium (Enter 050)

Zero ok !

Prepare Test

Start Test

1. After Zero Calibration the following is displayed:

2. Remove the cell from the cell compartment.

3. Add a CALCHECK-tablet, crush and mix well with a clean stirring rod. Fit the cell with a clean stopper.

4. Place the cell in the cell compartment and close the lid.

Test

5. Press TEST key.

02:00 Delay

is displayed briefly.

This indicates the time required for complete colour development.

The time remaining is displayed continuously starting from 2 minutes. The beeper sounds for the last 10 seconds of this time and then the test is carried out automatically.

Test ■ . . . . . .

then appears in the display.

Date Time

$CaCO_3$ (Ca) * mg/l**

The test result is displayed in mg/l as $CaCO_3$.

7. Press PRINT, STORE or select another test parameter as necessary.

5. Methods

Notes

1. Magnesium hardness up to 200 mg/l (as $CaCO_3$) does not interfere.
2. Iron concentrations greater than 10 mg/l produce lower values. Zinc concentration greater than 1 mg/l produce higher values.
3. Strongly acidic or strongly alkaline water should be adjusted to between pH4 and pH10 before testing.
4. The method has a greater tolerance at the high end of the test range than at the low end. When diluting samples, dilute so that measurement takes place in the bottom third of the range.

Conversion Table

mg/l $CaCO_3$ x 0.4 = mg/l Ca

	Alkaline Earth Ions mmol/l	Alkaline Earth Ions m.equiv/l	ppm $CaCO_3$	German Deg. °g	English Deg. °e	French Deg. °f
1 mg/l $CaCO_3$	0.01	0.020	1.00	0.056	0.07	0.10

Accuracy of method

This method was developed from a volumetric procedure for the determination of calcium. Due to undefined conditions, the deviations from the standardised method may be greater.

The detection limit (lowest concentration than can be determined) is 5 mg/l $CaCO_3$.

The relative standard deviation for spectrophotometric analyses with a wavelength of 575 nm is specified as 1.8 – 5.0 % (Lit 3).

5. Methods

0 5 1

5.17. Hardness / Total (Enter 051)

Zero ok !

Prepare Test

Start Test

1. After Zero calibration the following is displayed:

2. Remove the cell from the cell compartment.
3. Add a HARDCHECK-P-tablet, crush and mix well with a clean stirring rod. Ensure all particles are dissolved.
4. Fit the cell with a clean stopper.
5. Place the cell in the cell compartment and close the lid.

Test

6. Press the TEST key.

05:00 Delay

is displayed briefly.

This indicates the time necessary for full colour development.

The time remaining is displayed continuously starting from 5 minutes. The beeper sounds for the last 10 seconds of this time.

Test ■ . . . . . .

then appears in the display.

Date Time

$CaCO_3$ (total) * mg/l**

The test is then carried out automatically and the result displayed in mg/l $CaCO_3$.

7. Press PRINT, STORE or select another test parameter as necessary.

5. Methods

Notes

1. Strongly alkaline or acidic water must be brought within the pH values of 4 and 10 before the tablet is added.
2. The test operates with higher tolerances at the upper end of the test range than at the lower end. For best accuracy the sample should be diluted if necessary with deionised water to bring the result in the bottom third of the range.

Conversion factors

	Alkaline Earth ions	Alkaline Earth ions	ppm $CaCO_3$	German degrees °d	English degrees °e	French degrees °f
1 mg/l $CaCO_3$	0.01	0.020	1.00	0.056	0.07	0.10

5. Methods

0 5 4

5.18. Hydrazine (Enter 054)

Zero ok !

Prepare Test

Start Test

1. After Zero calibration the following is displayed:

2. Remove the cell from the cell compartment.

3. Add 1 g of HYDRAZINE-test powder to the cell using the 1 g spoon.

4. Fit a clean stopper to the cell, and mix the contents by shaking the cell. (Note 1)

5. The cell should then be placed immediately in the cell compartment and the lid closed.

Test

6. Press the TEST key.

10:00 Delay

is displayed briefly.

This indicates the time required for full colour development.

The time remaining is displayed continuously. The beeper sounds for the last 10 seconds of this time and the test is then carried out automatically.

Test ■ . . . . . .

then appears in the display.

Date Time

N_2H_4 * mg/l**

The result displayed in mg/l N_2H_4.

7. Press PRINT, STORE or select another test parameter as necessary.

5. Methods

Notes

1. The slight cloudiness produced on addition of the reagent has been compensated for and will not affect the test result. However, the sample itself must not be cloudy and should be filtered before carrying out the zero calibration.
2. The temperature of the sample taken for the test must not exceed 21 °C.
3. A blank test on the reagent should be carried out periodically using deionised water and the procedure above. If the result is greater than the detection limit below the use of the reagent in subsequent tests will lead to erroneous results.

5. Methods

1 5 0

5.19. Hydrogenperoxide (Enter 150)

Zero ok !

Prepare Test

Start Test

1. After Zero calibration the following is displayed:

2. Remove the cell from the cell compartment and empty except for a few drops of the water sample.

3. Add a HYDROGEN PEROXIDE LR-tablet, crush with a clean stirring rod.

4. Fill the cell to the 10 ml mark with the sample, mix well to dissolve with the stirring rod. Fit the cell with a clean stopper.

Test

5. Place the cell in the cell compartment, close the lid and press TEST key.

02:00 Delay

is displayed briefly.

This indicates the time allowed for full colour development.

The time remaining is displayed continuously starting from 2 minutes. The beeper sound for the last 10 seconds of this time and then the test is carried out automatically.

Test ■ . . . . . .

then appears in the display.

Date Time

H_2O_2 * mg/l**

The result is displayed in mg/l H_2O_2.

6. Press PRINT, STORE or select another parameter as necessary.

Note

Oxidizing agents, such as chlorine, ozone, bromine etc., interfere as they react like H_2O_2.

5. Methods

0 5 5

5.20. Iodine (Enter 055)

Zero ok !

Prepare Test

Start Test

1. After Zero calibration the following is displayed:

2. Remove the cell from the cell compartment and empty except for a few drops of the water sample.

3. Add a DPD No.1-tablet and crush with a clean stirring rod.

4. Fill to the 10 ml mark with the sample and mix well with the stirring rod. Fit cell with a clean stopper.

5. Place the cell in the cell compartment and close the lid.

Test

6. Press TEST key.

02:00 Delay

is displayed briefly.

This indicates the time required for full colour development.

The time remaining is displayed continuously starting from 2 minutes. The beeper sounds for the last 10 seconds of this time and then the test is carried out automatically.

Test ■ . . . . . .

then appears in the display.

Date Time

I * mg/l**

The result is displayed in mg/l iodine:

7. Press PRINT, STORE or select another parameter as required.

5. Methods

0 4 0

5.21. Iron [Iron (II) and Iron (III) Ions] (Enter 040)

Zero ok !

Prepare Test

Start Test

1. After Zero calibration the following is displayed:

2. Remove the cell from the cell compartment.

3. Add an IRON LR-tablet to the 10 ml water sample and crush and mix to dissolve. Fit the cell with a clean stopper.

Test

4. Place the cell in the cell compartment, close the lid and press TEST key.

05:00 Delay

is displayed briefly.

This indicates the time allowed for complete colour development.

The time remaining is displayed continuously starting from 5 minutes. The beeper sounds for the last 10 seconds of this time and then the test starts automatically.

Test ■ . . . . . .

then appears in the display.

Date Time

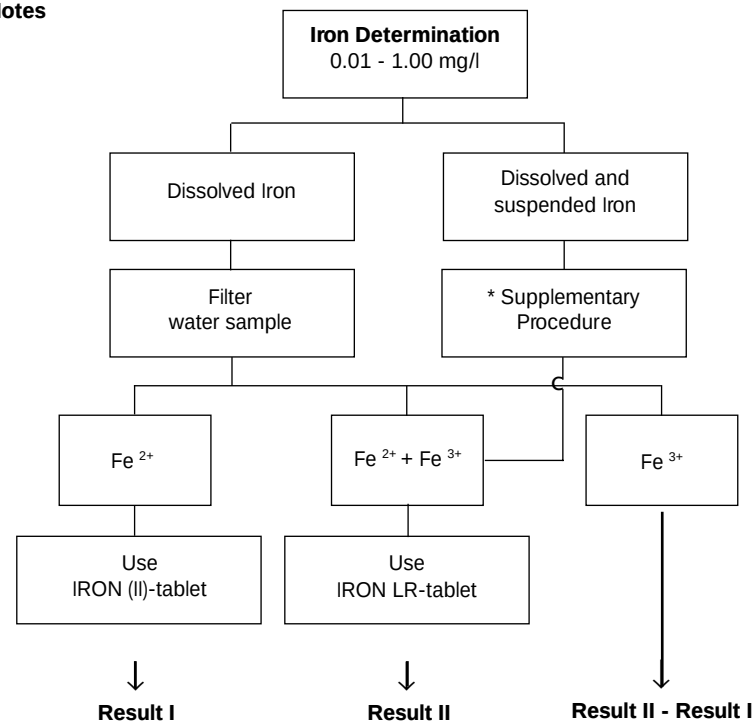
Fe * mg/l**

The result is displayed in mg/l as total dissolved iron.

5. Press PRINT, STORE or select another test parameter as necessary.

5. Methods

Notes



*** Supplementary Procedure**

Add 1 ml of concentrated sulphuric acid to 100 ml of the water sample. Heat and boil for 10 minutes or until all particles have dissolved. After cooling down the sample is set on a pH-value of 3 to 6 by using ammonia solution. Refill with destilled water to the previous volume of 10 ml. Mix well. Pour into a 13.5 mm, 10 ml moulded cell and fill to the 10 ml mark. Add an IRON LR-tablet, crush and mix well to dissolve. Allow to stand for 5 minutes. Water which has been treated with organic compounds as corrosin inhibitors must be oxidised where necessary to break down the iron complexes - add 1 ml of concentrated sulphuric acid and 1 ml of concentrated nitric acid to a 100 ml sample and boil to approximately half volume. After cooling down proceed with the analysis as described above.

5. Methods

0 7 3

5.3. Manganese (Enter 073)

Zero ok !

Prepare Test

Start Test

1. After Zero calibration the following is displayed:

2. Remove the cell from the cell compartment.

3. Add an MANGANESE LR 1-tablet to the 10 ml water sample, crush and mix carefully with a clean stirring rod.

4. Add an MANGANESE LR 2-tablet to the same sample, crush and mix **gently** with the same stirring rod.

5. Fit a stopper to the cell and ensure the tablets have dissolved completely.

6. Place cell immediately in the cell compartment, close the lid and press TEST key.

Test

05:00 Delay

is displayed indicating the time allowed for full colour development.

The time remaining is displayed continuously starting from 5 minutes. During this time, check at intervals that the solution is still bubble free and mix again if necessary. The beeper is actuated during the last 10 seconds before the full time has elapsed.

Test ■ . . . . . .

then appears in the display.

Date Time

Mn * mg/l**

The test is then carried out automatically and the result displayed in mg/l Manganese:

7. Press PRINT, STORE or select another test parameter as required.

5. Methods

0 7 5

5.23. Molybdate (Enter 075)

Zero ok !

Prepare Test

Start Test

1. After zero calibration the following is displayed:

2. Remove the cell from the cell compartment and empty it completely.
3. Fill a clean and dry 40 mm cell to the 20 ml mark with sample.
4. Add a MOLYBDATE No. 1 HR-tablet to the sample, crush with a clean stirring rod and mix to dissolve.
5. Add a MOLYBDATE No. 2 HR-tablet to the same sample, crush and mix well to dissolve using the stirring rod.
6. Rinse out the cell used for the zero calibration with this solution then fill to the 10 ml mark. Fit the cell with a stopper.

Test

7. Place the cell immediately in the cell compartment, close the lid and press TEST.

Test ■ . . . . . .

then appears in the display.

Date Time

MoO_4 * mg/l N**

The result is then displayed in mg/l MoO_4.

8. Press PRINT, STORE or select another test parameter as necessary.

5. Methods

Notes

1. The tablets must be added in the correct sequence.
2. Under the test conditions (pH 3.8 to 3.9) iron does not interfere nor do other metals at levels likely to be found in industrial water systems.

Conversions

From MoO_4 to Na_2MoO_4 multiply by 1.3
From MoO_4 to Mo multiply by 0.6

5. Methods

0 8 5

5.24. Nitrate (Enter 085)

Zero ok !

Prepare Test

Start Test

1. After Zero calibration the following is displayed:

2. Remove the cell from the cell compartment and empty it completely.

3. Fill the Nitrate test tube with sample to the 20 ml mark, add 1 level spoon of NITRATE TEST powder, close the tube and shake vigorously for 1 minute. Then add one NITRATE TEST-tablet and again shake vigorously for 1 minute.

4. Stand the tube upright and after the reducing agent has settled to the bottom, gently invert it three to four times so as to complete the flocculation of the reducing agent. Then let the tube stand for a further 2 minutes.

5. Carefully decant 10 ml of the treated solution into the 10 ml cell used for zeroing, ensuring that no reducing agent is carried over (filter if necessary).

6. Add a NITRITE LR-tablet to the 10 ml water sample, crush and mix well to dissolve. Fit the cell with a clean stopper.

Test

7. Place the cell immediately in the cell compartment, close the lid and press TEST.

10:00 Delay

is displayed briefly.

This allows the time necessary for full colour development. The time remaining is displayed continuously starting from 10 minutes. The beeper sounds for the last 10 seconds of this time and the test is then carried out automatically.

Test ■ . . . . . .

then appears in the display.

Date Time

The result is displayed in mg/l as N.

NO_3 * mg/l N**

8. Press PRINT, STORE or select another parameter as necessary.

5. Methods

Notes

1. If Nitrite is present in the sample as well as nitrate, it will react with the NITRITE LR-tablet, leading to a high result. To allow for the nitrite present, carry out a nitrite determination (see page 93) and subtract the result from the nitrate reading to give the corrected result.

2. Concentration of nitrate nitrogen above 1 mg/l (e.g. 50 mg/l) lead to an apricot colour instead of the reddish pink solution after the reaction time of 10 minutes. This colour cannot be correctly measured by the photometer. The result displayed does not show the concentration of nitrate nitrogen. The range of the test can be extended by first diluting the water sample with deionised water. One standard method is to dilute 1.0 ml of sample up to 100 ml (dilution factor of 100). The subsequent result of the test must then be multiplied by the dilution factor.

3. The following ions can produce interference as under the reaction conditions they can cause precipitation : antimony(III), iron(III), lead, mercury(I), silver, chloroplatinate, metavanadate and bismuth. Copper(II) ions may give a low result as they accelerate the decomposition of the diazonium salt.

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

4. To convert from mg/l as N to mg/l as NO_3 multiply by 4.4.

5. Methods

0 8 6

5.25. Nitrate HR (Enter 086)

Zero ok !

Prepare Test

Start Test

1. After Zero calibration the following is displayed:

2. Remove the cell from the cell compartment.

3. Add an NITRATE HR 1-tablet to the 10 ml water sample, crush and mix carefully with a clean stirring rod.

4. Add an NITRATE HR 2-tablet to the same sample, crush and mix **gently** with the same stirring rod.

5. Fit a stopper to the cell and ensure the tablets have dissolved completely.

6. Place cell immediately in the cell compartment, close the lid and press TEST key.

Test

10:00 Delay

is displayed indicating the time allowed for full colour development.

The time remaining is displayed continuously starting from 10 minutes. During this time, check at intervals that the solution is still bubble free and mix again if necessary. The beeper is actuated during the last 10 seconds before the full time has elapsed.

Test ■ . . . . . .

then appears in the display.

The test is then carried out automatically and the result displayed in mg/l NO_3:

Date Time

NO3 * mg/l**

7. Press PRINT, STORE or select another test parameter as required.

8. mg/l = mg/l NO_3 x 0.227

5. Methods

0 9 0

5.26. Nitrite (Enter 090)

Zero ok !

Prepare Test

Start Test

1. After Zero calibration the following is displayed:

2. Remove the cell from the cell compartment.

3. Add a NITRITE LR-tablet, crush and mix well with a clean stirring rod. Fit the cell with a clean stopper.

4. Place the cell in the cell compartment and close the lid.

Test

5. Press TEST key.

10:00 Delay

is displayed briefly.

This allows the time necessary for full colour development.

The time remaining is then displayed continuously starting from 10 minutes. The beeper sounds for the last 10 seconds of this time and the test is then carried out automatically.

Test ■ . . . . . .

then appears in the display.

Date Time

NO_2 * mg/l N**

The result is displayed in mg/l as N.

6. Press PRINT, STORE or select another parameter as necessary.

5. Methods

Notes

1. The following ions can produce interference since under the reaction conditions they cause precipitation: antimony (III), iron (III), lead, mercury (I), silver, chloroplatinate, metavanadate and bismuth.
   Copper (II) ions may give a low result as they accelerate the decomposition of the diazonium salt.

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

2. To convert from mg/l as N to mg/l as NO_2 multiply by 3.3.

5. Methods

0 9 1

5.27. Nitrite HR (Enter 091)

The sample is filtered if necessary, so as to obtain a clear solution. Exactly 1 ml of the filtrate is taken (by pipette or syringe) and transferred to a clean cell. Nitrite-free water (deionised) is added, filling to the 10 ml mark. The cell is then placed in the cell compartment and the zero calibration carried out.

Zero ok !
Prepare Test
Start Test

1. After Zero calibration the following is displayed:

2. Add a NITRITE HR No. 1-tablet, crush and mix well with a clean stirring rod.

3. A NITRITE HR No. 2-tablet is added to the same sample and is crushed and mixed with the stirring rod. Ensure all particles are dissolved.

4. Fit the cell with a clean stopper.

Test

5. Place the cell in the cell compartment and press the TEST key.

02:00 Delay

is displayed briefly.

This indicates the time required for full colour development.

The time remaining is displayed continuously. The beeper sounds for the last 10 seconds of this time and test is then carried out automatically.

Test ■ . . . . . .

then appears in the display.

Date Time
$NaNO_2$ * mg/l**

The result is displayed in mg/l $NaNO_2$.

6. Press PRINT, STORE or select another test parameter as necessary.

5. Methods

Notes

1. The tablets must be added in the correct order.
2. The sample should have a pH value between 6 and 10.
3. The method is specially designed for process waters. The sample must be below 30 °C before the test is carried out.

5. Methods

1 2 9

5.28. Oxygen (dissolved) (Enter 129)

Insert the adaptor (for tubes 13 mm in diameter) into the cell compartment and carry out a zero calibration using the zero tube supplied with the oxygen reagents. This is filled with deionised water.

Zero ok !

1. After calibration the following is displayed:

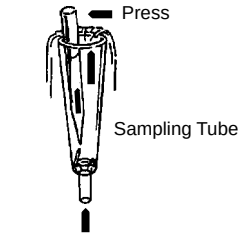
Prepare Test

2. Remove the zero tube and replace in the kit.

Start Test

3. The water to be tested is passed through the special sampling vessel for several minutes to remove any air bubbles adhering to the surface. The water enters at the bottom and overflows from the top.

4. When all air bubbles have disappeared a Vacu-Vial™ ampoule is taken and the point of the ampoule is pressed into one of the lower corners of the sampling vessel. The ampoule is broken by slight extra pressure and the water sample fills the ampoule. A small volume of inert gas remains in the ampoule so the contents can be mixed by inversion.



Note

As the product of the reaction is denser than water it is important to remove the ampoule from the sampling vessel within 5 seconds to prevent any loss of this. The reading must be taken within 30 seconds after breaking the ampoule. On removal of the ampoule, point downwards, the end is closed by means of a gloved finger - to prevent entry of air. The ampoule is inverted several times, the outside dried and then placed in the cell compartment and the lid closed.

Test

4. Press the TEST key.

Date Time

O_2 * µg/l**

The result is displayed in µg/l oxygen.

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Neither the sample temperature, the salt content nor other dissolved gases affect the result. Oxidation agents can lead to increased values (ASTM Power Plant Manual, first edition, p.169 (1984)).

5. Methods

0 9 5

5.29. Ozone (Enter 095)

Zero ok !
Ozone / Cl = 1
Ozone = 2
Select 1 or 2

1. After Zero calibration the following is displayed:

1

2. Press key [1] to determine ozone in the presence of chlorine.

2

3. Press key [2] to determine ozone in the absence of chlorine.

Ozone in the presence of chlorine

1

1. Press key [1].

T1 prepare !
T1 start

then appears in the display.

2. Remove the cell from the cell compartment and empty except for a few drops of the water sample.
3. Add a DPD No. 1-tablet and a DPD No. 3-tablet and crush with a clean stirring rod.
4. Fill the cell to the 10 ml mark with the sample. Mix gently at first, then more vigorously with the stirring rod. Fit the tube with a clean stopper.

5. Methods

5. Place the cell in the cell compartment and close the lid.

Test

6. Press TEST key.

T1 Test ok!

T2 prepare !

T2 start

then appears in the display.

7. Remove the cell from the cell compartment, clean thoroughly and add a few drops of the water sample.

8. Add a DPD No. 1 and a DPD No. 3-tablet. Crush with a clean stirring rod.

9. Fill a second cell to the 10 ml mark with the sample. Add a Glycine tablet and crush and mix, gently at first but then more vigorously with stirring rod.

10. Add the contents of the second tube to the first tube. Mix well with the stirring rod. Fit the cell with a clean stopper.

Test

11. Place the cell in the cell compartment, close the lid and press TEST key.

Test ■ . . . . . .

then appears in the display.

Date Time

O_3 * mg/l (as Ozone)**

tot Cl * mg/l (as Chlorine)**

The result is displayed giving both the ozone and chlorine concentrations in mg/l.

12. Press PRINT, STORE or select another parameter as necessary.

5. Methods

Ozone in the absence of chlorine

1. Press key [2].

Prepare Test

Start Test

The following is displayed :

2. Remove the cell from the cell compartment and empty except for a few drops of the water sample.
3. Add a DPD No. 1-tablet and a DPD No. 3-tablet. Crush with a clean stirring rod.
4. Fill the cell to the 10 ml mark with the sample, mix gently at first, then more vigorously with the stirring rod.

5. Place the cell in the cell compartment, close the lid and press the TEST key.

Test ■ . . . . . . then appears in the display.

Date Time

The result is then displayed as ozone in mg/l.

O_3 * mg/l**

6. Press PRINT, STORE or select another parameter as necessary.

5. Methods

Notes

The analysis must be carried out immediately after taking the sample.

The DPD colour development requires a pH of 6.3 – 6.5 . The reagent tablets therefore contain a buffer for pH adjustment.

Strongly alkaline or acidic water must however be neutralized before the analysis.

Bleaching of the DPD by higher levels of ozone or chlorine can produce results within the measuring range. The presence of such higher levels are indicated, when the tablet is crushed initially, if a deep red colour is given which decreases when the water sample is added. Should this occur, carefully dilute the sample and retest, multiplying the result by the dilution factor.

5. Methods

1 0 0

5.30. Ozone / Indigo (Enter 100)

Zero ok !

Prepare Test

Start Test

1. After Zero calibration the following is displayed:

2. Remove the cell from the cell compartment and empty completely.
3. Rinse a **20 ml** moulded cell with the sample and empty except for a few drops of sample.
4. Add an OZONE-tablet. Crush with a clean stirring rod.
5. Carefully fill the cell to the 20 ml mark.
6. Mix the sample gently at first, with the stirring rod until all particles have completely dissolved.
7. When the tablet has dissolved completely, transfer 10 ml to the cell used for the zero calibration.
8. Place this cell in the cell compartment and close the lid.

Test

9. Press TEST key.

Test ■ . . . . . .

then appears in the display.

Date Time

O_3 * mg/l**

The result is displayed in mg/l ozone.

10. Press PRINT, STORE or select another parameter as necessary.

5. Methods

Notes

1. Interference by chlorine and bromine is eliminated by malonic acid in the tablet.
2. Hydrogen peroxide and organic peroxides react very slowly and so rarely cause interference.
3. Fe (III) does not interfere.
4. Mn (II) is oxidized by ozone and interferes.

5. Methods

1 0 5

5.31. pH Value - Bromocresol Purple 5.2 – 6.8

(Enter 105)

Zero ok !

Prepare Test

Start Test

1. After Zero calibration the following is displayed:

2. Remove the cell from the cell compartment.

3. Add a BROMOCRESOLPURPLE PHOTOMETER-tablet. Crush and mix well with a clean stirring rod. Fit cell with a clean stopper.

Test

4. Place the cell in the cell compartment, close the lid and press TEST key.

Test ■ . . . . . .

then appears in the display.

Date Time

pH ***

The result is displayed as a pH value.

5. Press PRINT, STORE or select another parameter as necessary.

Notes

For photometric determination of pH values, only BROMOCRESOLPURPLE-tablets marked Photometer should be used.

pH values less than 5.2 or above 6.8 can give readings within the test range. Readings at either end of the scale should be checked, where possible by another indicator e.g. if the reading is 6.8., check this value by using phenolred (see page 109).

5. Methods

Accuracy of the Method

The accuracy of the colorimetric determination of the pH value is dependent on various boundary conditions (buffer capacity of the sample, salt content etc.).

Salt Error

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

Indicator	Salt Content		
	1 Molar	2 Molar	3 Molar
Bromocresolpurple	-0.26	-0.33	-0.31

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

5. Methods

1 1 0

5.32. pH Value - Phenolred 6.5 - 8.4 (Enter 110)

Zero ok !

Prepare Test

Start Test

1. After Zero calibration the following is displayed:

2. Remove the cell from the cell compartment.

3. Add a PHENOLRED PHOTOMETER tablet. Crush and mix well with a clean stirring rod. Fit the cell with a clean stopper.

Test

4. Place the cell in the cell compartment, close the lid and press TEST key.

Test ■ . . . . . .

then appears ion the display.

Date Time

The result is displayed as a pH value.

pH ***

5. Press PRINT, STORE or select another parameter as necessary.

Notes

For photometric determination of pH values, only PHENOLRED-tablets marked Photometer should be used.

pH values less than 6.5 or above 8.4 can give readings within the test range. Readings at the bottom end of the range may be checked using bromocresol purple (see page 107). Readings at the top end of the range may be checked using thymolblue (see page 111).

Samples with a low alkalinity-m may give wrong pH-readings.

5. Methods

Accuracy of the Method

The accuracy of the colorimetric determination of the pH value is dependent on various boundary conditions (buffer capacity of the sample, salt content etc.).

Salt Error

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

Indicator	**Salt Content**		
	1 Molar	2 Molar	3 Molar
Phenolred	-0.21	-0.26	-0.29

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

5. Methods

1 1 5

5.33. pH Value - Thymolblue 8.0 – 9.6 (Enter 115)

Zero ok !

Prepare Test

Start Test

1. After Zero calibration the following is displayed:

2. Remove the cell from the cell compartment.

3. Add a THYMOLBLUE PHOTOMETER-tablet. Crush and mix well with a clean stirring rod. Fit cell with a clean stopper.

Test

4. Place the cell in the cell compartment, close the lid and press TEST key.

Test ■ . . . . . .

then appears in the display.

Date Time

pH *

The result is displayed as a pH value.

5. Press PRINT, STORE or select another parameter as necessary.

Notes

For photometric determination of pH values, only THYMOLBLUE-tablets marked Photometer should be used.

pH values less than 8.0 or above 9.6 can give readings within the test range. Readings at either end of the scale should be checked, where possible by other means e.g. if the reading is 8.0, check this value by using phenolred (page 109).

5. Methods

Accuracy of the Method

The accuracy of the colorimetric determination of the pH value is dependent on various boundary conditions (buffer capacity of the sample, salt content etc.).

Salt Error

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

Indicator	Salt Content		
	1 Molar	2 Molar	3 Molar
Thymolblue	-0.22	-0.29	-0.34

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

5. Methods

1 2 0

5.34. Phosphate LR (Enter 120)

Zero ok !

Prepare Test

Start Test

1. After Zero calibration the following is displayed:

2. Remove the cell from the cell compartment.

3. Add a PHOSPHATE LR No. 1-tablet. Crush and mix well with a clean stirring rod.

4. Add a PHOSPHATE LR No. 2-tablet. Crush and mix well to dissolve, with the stirring rod. Fit the tube with a clean stopper.

Test

5. Place the cell in the cell compartment, close the lid and press TEST key.

10:00 Delay

is displayed briefly.

This allows the time necessary for complete colour development.

The time remaining is then displayed continuously starting from 10 minutes. The beeper sounds for the last 10 seconds of this time and the test is then carried out automatically.

Test ■ . . . . . .

then appears in the display.

Date Time

PO_4 * mg/l**

The result is displayed in mg/l PO_4.

6. Press PRINT, STORE or select another parameter as necessary.

5. Methods

Notes

1. The tablets must be added in the correct sequence.
2. The test sample should have a pH of between 6 and 7. Only orthophosphate Ions react.
3. Interferences
   Higher concentrations of Cu, Ni, Cr (III) and V (V) can interfere due to their colour. Silicates do not interfere (masked by citric acid in the tablets).

Conversions

To convert from mg/l as PO_4 to mg/l as P_2O_5 multiply by 0.75
To convert from mg/l as PO_4 to mg/l as P multiply by 0.33

5. Methods

1 **2** **5**

5.35. Phosphate HR (Enter 125)

Zero ok !

Prepare Test

Start Test

1. After Zero calibration the following is displayed:

2. Remove the cell from the cell compartment.

3. Add a PHOSPHATE HR P1-tablet. Crush and mix well with a clean stirring rod.

4. Add a PHOSPHATE HR P2-tablet. Crush and mix well to dissolve, with the stirring rod. Fit the tube with a clean stopper.

Test

5. Place the cell in the cell compartment, close the lid and press TEST key.

10:00 Delay

is displayed briefly.

This allows the time necessary for complete colour development.

The time remaining is then displayed continuously starting from 10 minutes. The beeper sounds for the last 10 seconds of this time and the test is then carried out automatically.

Test ■ . . . . . .

then appears in the display.

Date Time

PO_4 * mg/l**

The result is displayed in mg/l PO_4.

6. Press PRINT, STORE or select another parameter as necessary.

5. Methods

Note

Only Orthophosphate ions react.

Conversions

To convert from mg/l as PO_4 to mg/l as P_2O_5 multiply by 0.75
To convert from mg/l as PO_4 to mg/l as P multiply by 0.33

5. Methods

5.36. Potassium (Enter 060)

Zero ok !	1. After Zero calibration the following is displayed:
Prepare Test	
Start Test	
	2. Remove the cell from the cell compartment.
	3. Add a POTASSIUM T-tablet to the 10 ml water sample, crush and mix well with a clean stirring rod. Fit a clean stopper to the cell. If potassium is present, a cloudy solution will be given.
	4. Place the cell in the cell compartment and close the lid.
	5. Press TEST key.
Test ■	then appears in the display.
Date Time	The result is then displayed in mg/l potassium.
K * mg/l**	
	6. Press PRINT, STORE or select another test parameter as necessary.

5. Methods

1 **3** **0** **5.37. Silica / Silicon dioxide** (Enter 130)

Zero ok !	1. After Zero calibration the following is displayed:
Prepare Test	
Start Test	
	2. Remove the cell from the cell compartment.
	3. Add a SILICA No. 1-tablet to the sample, crush and mix to dissolve using a clean stirring rod.
	4. Allow 5 minutes for reaction time. (Use the countdown function (see page 38). The unit retains the zero from the calibration.
	5. Add a SILICA PR-tablet. Crush and mix to dissolve (see Remarks).
	6. Add a SILICA No. 2-tablet. Crush and mix to dissolve, using the stirring rod. Fit the cell with a clean stopper.
Test	7. Place the cell in the cell compartment, close the lid and press TEST key.
01:00 Delay	is displayed briefly.
	This allows the time necessary for full colour development.
	The time remaining is then displayed continuously starting from 1 minute. The beeper sounds for the last 10 seconds of this time. The test then starts automatically.
Test ■	then appears in the display.
Date Time	The result is displayed in mg/l SiO_2.
SiO_2 * mg/l**	
	7. Press PRINT, STORE or select another parameter as necessary.

5. Methods

Note

The tablets must be added in the correct sequence. Phosphate does not interfere under the given reaction conditions. If phosphate is known to be absent, the addition of SILICA PR-tablet may be omitted.

5. Methods

0 8 0

5.38. Sodium hypochlorite (Enter 080)

1. Dilute sample 2000 times (see Remarks) and carry out a Zero calibration with this dilution.

Zero ok !

Prepare Test

Start Test

2. After Zero calibration the following is displayed:

3. Remove the cell from the cell compartment.

4. Add an ACIDIFYING GP-tablet to the 10 ml water sample and crush and mix well with a clean stirring rod.

5. Add a CHLORINE HR (potassium iodide)-tablet to the same sample and crush and mix well with the stirring rod. Stopper the cell.

Test

6. Place the cell immediately in the cell compartment, close the lid and press TEST.

Test ■ . . . . . .

then appears in the display.

The result is then displayed as w/w of available chlorine in the original sample of sodium hypochlorite:

Date Time

NaClO * w/w %**

7. Press PRINT, STORE or select another parameter as necessary.

5. Methods

Notes

A 2000 times dilution is produced in two steps.

1. Fill the 5 ml syringe to the 5 ml mark with the solution under test ensuring all air bubbles are expelled and expel this 5 ml into a clean 100 ml container. Dilute to the 100 ml mark with chlorine-free water. Mix well.
2. Use the 1 ml syringe to measure 1 ml of the diluted solution from (1) into another 100 ml container. Dilute to the 100 ml mark with chlorine-free water. Mix well. Use this solution for the test.

5. Methods

1 **3** **5**

5.39. Sulfate (Enter 135)

Zero ok !

Prepare Test

Start Test

1. After Zero calibration the following is displayed:

2. Remove the cell from the cell compartment.

3. Add a SULFATE TURBIDITY-tablet to the sample. Crush and mix well with a clean stirring rod. Fit cell with a clean stopper. If Sulfate is present a cloudy solution will be given.

4. Place the cell in the cell compartment and close the lid.

Test

5. Press TEST key.

Test ■ . . . . . .

then appears in the display.

Date Time

SO_4 * mg/l**

The result is displayed in mg/l SO_4.

6. Press PRINT, STORE or select another parameter as necessary.

5. Methods

1 **4** **0** **5.40. Sulfide** (Enter 140)

Zero ok !

Prepare Test

Start Test

1. After Zero calibration the following is displayed:

2. Remove the cell from the cell compartment.

3. Add a SULFIDE No.1-tablet to the sample.

4. Add a SULFIDE No. 2-tablet to the sample. Crush both tablets carefully and mix gently to avoid loss of the sulphide. Continue until the tablets are dissolved. Fit the cell with a clean stopper.

Test

5. Place the cell immediately in the cell compartment, close the lid and press TEST key.

10:00 Delay

is displayed briefly.

This allows the time required for full colour development.

The time remaining is then displayed continuously starting from 10 minutes. The beeper sounds for the last 10 seconds of this time.

Test ■ . . . . . .

then appears in the display.

Date Time

S * mg/l**

The result is displayed in mg/l S.

6. Press PRINT, STORE or select another parameter as necessary.

5. Methods

Notes

1. The tablets must be 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.

Conversion

To convert mg/l as sulfide S, to mg/l as hydrogen sulfide, H_2S, multiply by 1.06.

5. Methods

1 4 5

5.41. Sulfite (Enter 145)

Zero ok !

Prepare Test

Start Test

1. After Zero calibration the following is displayed:

2. Remove the cell from the cell compartment.

3. Add a SULFITE P-tablet, crush and mix well, carefully at first, with a clean stirring rod. Fit the cell with a clean stopper.

Test

4. Place the cell in the cell compartment, close the lid and press TEST key.

02:00 Delay

is displayed briefly.

This indicates the time allowed for full colour development.

The time remaining is displayed continuously starting from 2 minutes. The beeper sounds during the last 10 seconds of this time.

Test ■ . . . . . .

then appears in the display.

Date Time

Na_2SO_3 * mg/l**

The test is then carried out automatically and the result displayed in mg/l Na_2SO_3.

5. Press PRINT, STORE or select another parameter as necessary.

Notes

Nitrite (up to 200 mg/l), Iron (up to 20 mg/l), sulfide (up to 10 mg/l) and chlorine (up to 250 mg/l) do not interfere.

Tannin or tannin-containing boiler water additives cause low results.

5. Methods

1 **5** **5** **5.42. Zinc** (Enter 155)

Zero ok !

Prepare Test

Start Test

1. After Zero calibration the following is displayed:

2. Remove the cell from the cell compartment.

3. Add a COPPER / ZINC LR-tablet. Crush and mix to dissolve with a clean stirring rod. Fit the cell with a clean stopper.

Test

4. Place the cell in the cell compartment, close the lid and press the TEST key.

05:00 Delay is displayed briefly.

This indicates the time allowed for complete colour development.

The time remaining is displayed continuously starting from 5 minutes. The beeper sounds for the last 10 seconds of this time and the test is then carried out automatically.

Test ■ . . . . . . then appears in the display.

Date Time

Zn * mg/l**

The result is displayed in mg/l Zn.

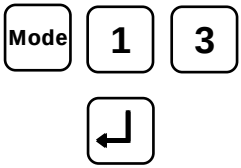
5. Press PRINT, STORE or select another test parameter as necessary.

5. Methods

Notes

a) The presence of copper will give high readings as it reacts with the indicator in the same way as zinc does. To correct for this, after the reading has been given in 5) above, note the result.

Remove the cell from the cell compartment. Add one EDTA tablet. Crush and mix to dissolve. This removes that part of the colour due to the zinc. Return the cell to the compartment and close the lid.



1. Press MODE [1] [3] in succession then ENTER.

Delay Auto
YES = 1 NO = 2

The following is displayed:

2. Press [2] then TEST.

Same Sample?

is then displayed.

3. Press TEST twice.

Date Time
Zn *, mg/l**

The result is displayed in mg/l Zn.

Note this result. This gives the concentration of copper in the sample. The difference between the two readings is the zinc concentration.

5. Methods

b) Some bleaching of the colours may be observed in this test, due to :

i) high levels of zinc or
ii) high levels of residual chlorine.

If i) is suspected, dilute the sample with zinc free (e.g.deionised) water and repeat the test, multiplying the result by the dilution factor.

If ii) is the case, repeat the test on a water sample after dechlorination. To dechlorinate the sample, after zero calibration, first add a dechlor tablet, crush and mix to dissolve. Then add the COPPER / ZINC LR-tablet and continue with the test procedure from 3) above.

5. Methods

5.43. User Polynomials

Under the method numbers 800, 810 and 820 the user can call up three polynomials in the form :

$$y = A + Bx + Cx^2$$

with x = mAbs at the specified wavelength
y = concentration (mg/l)
A, B, C polynomial coefficients.

For entering values of A, B and C acid the required wavelength for these polynomials, (see Mode 60, page 28).

These polynomials allow the use of the instrument to carry out tests for parameters not covered by the predetermined methods.

5. Methods

5.44. Absorption Wavelengths

Under the method numbers :

975 for = 470 nm
980 for = 528 nm
985 for = 580 nm
990 for = 605 nm
995 for = 660 nm

The absorption, by coloured solutions of know concentrations, can be measured in absorption units (mAbs) at the relevant wavelengths.

Zero ok !

Prepare Test

Start Test

1. After Zero calibration the following is displayed:

2. Remove the cell from the cell compartment and carry out the colour development in accordance with analysis specification used on a solution of known concentration.

Test

3. Place the cell in the cell compartment, close the lid and press TEST key.

Date Time

****** mAbs (528)**

The result appears in the display in mAbs (1 Abs = 1000 mAbs) e.g. with = 528 nm

Notes

The result obtained is specific to this equipment and cannot be utilised in other photometers of the PC 22 type or other makes.

The data pairs obtained with this program: i.e. mAbs of concentration (mg/l) at the specified wavelength can be used for preparing a polynomial (second degree or smaller) and stored in the memory under the No's 800, 810, 820.

For polynomial preparation, see page 28 (Mode 60).

6. Software

To transfer the data files stored in the Photometer memory to a PC (IBM compatible), use the following installation instructions:

PC-File

6.1. Connecting the PC 22 to the computer

1. Switch off computer and Photometer.
2. Connect Photometer and serial interface of computer with cable (use adapter for 25-pin serial interface). The cable must have the configuration shown in the following sketch:

PC 22		**IBM PC/AT**	
DB 9M		DB 9F	
PIN	SIGNAL	SIGNAL	PIN
2	RXD	TXD	3
3	TXD	RXD	2
7	RTS	CTS	8
8	CTS	RTS	7
5	GROUND	GROUND	5

6.2. Installing software

1. Insert disk in drive A or B.
2. Create a directory on the hard disk with the following DOS command:
   md \pc-file
3. Copy software from diskette to hard disk:
   copy a:/*.* c: \pc-file or
   copy b:/*.* c: \pc-file

6. Software

6.3. Starting program

1. The directory is called up by the following entry:
   cd pc-file "↵ "

2. Program starts after entering:
   pc-file "↵ "

3. Naming Files
   When starting the program, a name can be allocated to the file in which the data is stored (e.g. pc-file data). If a special name is not selected, the file will automatically name Photomet.Dat.

4. Selecting interface
   When starting the program, the serial interface used can be indicated (e.g. pc-file/2). If an interface is not indicated, the first interface will automatically be selected by the program.

   After starting the program, arriving data will be shown directly on the screen. The measurement value can then be directly transferred by the Photometer by pressing the PRINT key. Similarly data files already stored can be transmitted by means of the Mode function 20, 21, 22 and 23 (see Photometer manual).

   Data transfer is stopped by pressing any key on the computer. The data is automatically stored on the hard disk in the file designated at the start of the program or to the default file. Print this file by typing PRINT PHOTOMET. DAT.

Note

The interface used must not be utilized at the same time by another program (e.g. mouse driver).

7. Expansions

7.1. Reference filter

Technical data

Photometer type:	PC 22
Serial No.	. . . . .
Method No.	975 = mAbs (470 nm) 980 = mAbs (528 nm) 985 = mAbs (580 nm) 990 = mAbs (605 nm) 995 = mAbs (660 nm)
Reference filter	YELLOW for 470 nm RED for 528 nm BLUE for 580 nm 605 nm 660 nm
Tolerance	Individual readings in mAbs (see table overleaf) ± 5 mAbs

Note

1. The reference filters are specific to the photometer with the serial number given above. These must not be used for checking other photometers.
2. The reference filters are used for checking the reproducibility of test results in the various wavelengths. The wavelengths for the individual methods are listed in the operating instruction under "1.3. Test Parameter" and in the brief instruction under "Selection of methods with the photometer PC 22". The measured values in mAbs do not relate to the accuracy of the test result.
3. The cell with the reference filter must be clean on the inside and on the outside and free of finger marks, particularly at the level at which the filter is fitted. The cell is sealed with a stopper. This should never be removed.
4. If the measured value is found to be outside the specified value ±5 mAbs in spite of the fact that the correct reference filter was used, the cell compartment of the photometer should be thoroughly cleaned using the cleaning kit. The cell with the reference filter must also be cleaned (when dry). The instrument is then zeroed and the measurement repeated. If the measurement value is still outside the indicated range, we recommend that you have the photometer checked by a Tintometer Company.

7. Expansions

1. Switch on the photometer by pressing the ON/OFF key.

2. Select the method number corresponding to the wavelength to be checked and confirm by pressing the RETURN key twice.

3. The instrument is zeroed by pressing the ZERO key with the cell compartment empty and the photometer lid closed.

4. Place the clean cell with the relevant reference filter (as indicated in the table below) in the cell compartment with the graduation to the front (the filter is located in the left-hand side of the cell) and close the photometer lid.

5. Press the TEST key.

*** * * mAbs**

The measurement result appears in the dipslay in mAbs.

6. Press the TEST key three times to repeat the measurement process.

Method No.	Wavelength ranges (nm)				
	470 nm YELLOW	528 nm RED	580 nm BLUE	605 nm BLUE	660 nm BLUE
975	.....mAbs				
980		.....mAbs			
985			.....mAbs		
990				.....mAbs	
995					.....mAbs

Note

If a measured value outside the tolerance of ±5 mAbs appears in the display, check whether you have used the correct reference filter (YELLOW, RED or BLUE) as shown in the table.

8. Declaration of CE-Conformity

Declaration of CE-Conformity

The manufacturer: **Tintometer GmbH**

Schleefstraße 8 a
D - 44287 Dortmund
Germany

declares that this product

Product name: **PC 22**

with all optional items conforms to the following regulations:

EMC **EN 50081-1: 1993 (EN 55022 and EN 60555)**
EN 50082-1: 1992

The product conforms to the regulations of the EMC Directive 89/336/EEC.

Technical changes without notice.
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