Description of individual parameters and tests

Contents

Test kits for water analysis

VISOCOLOR® test kits and reagent cases

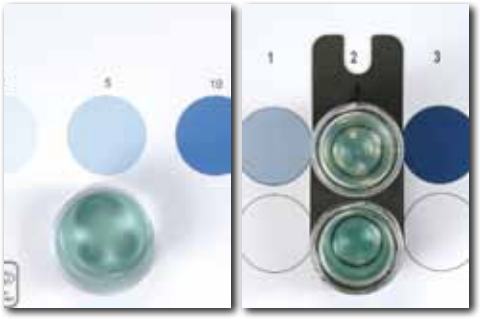
Compact and flexible

- Complete mini-laboratories with reagents and accessories for water analysis
- Chemical analysis without additional accessories and without the need for any prior experience in chemistry
- Suitable for analysis in labs or directly on-site
- 3 product lines with different accuracies, precisions and sensitivities for universal use depending on the analytical requirement
- Various measuring methods and detection principles for all parameters from acidity to zinc
- *VISOCOLOR*® reagent cases as portable laboratories with individual combinations of different test kits

Simple and precise

- Comfortable test procedures since test kits are based on simple chemical-analytical methods like colorimetry and titration
- Instructions in different languages and with pictograms for safe and simple test performance
- Color-coded reagent bottles for clear identification of reagents
- Fast-dissolving reagents save time and facilitate the daily work – no crushing of tablets and no stirring of reaction solutions are necessary

Reliable and safe



- Reliable and comparable results – the reaction principles of *VISOCOLOR*® tests are based on internationally acknowledged regulations like DIN-, EN-, ISO- and EPA standards
- Maximum safety for the user and easy disposal of used reagents by avoiding of dangerous and environmentally hazardous substances
- Low susceptibility to interferences, high selectivity with regards to the substance to be analyzed as well as compensation of turbidities and colors guarantee reliable results
- Additional increase of accuracy and reproducibility by photometric determination of *VISOCOLOR*® *ECO* tests with the photometer PF-12

VISOCOLOR® alpha tests use colorimetric, as well as titrimetric procedures. Use of multicomponent reagents results in a very convenient, rapid and safe handling, because often only one reagent is needed for each test.

The reagent bottles are packed in practical blister packs. The cardboard back is used for opening and closing the package, and also provides all information required for the test: instructions for use in 6 languages with pictograms, as well as a color comparison chart for colorimetric evaluations. The blister packs of the *VISOCOLOR® alpha* test kits have a punched hole for convenient storage or display in showrooms or at sales counters.

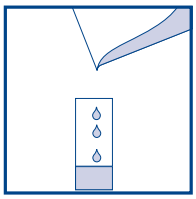
Colorimetric tests

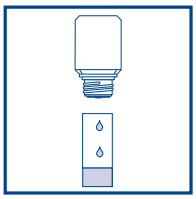
Principle:
Colorimetry with color comparison card

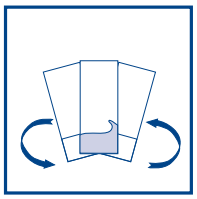
- Visual evaluation
- Environment-friendly
- Cost-efficient
- Convenient handling, as easy as test strips
- Accurate results
- Handy packages
- With pictogram instructions
- Reagent bottles with clear dosing instructions

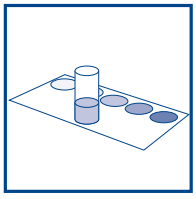
Test kit consists of plastic pack with:

- Sample tube with 5 mL ring mark
- Color coded bottles with liquid or powder reagents
- Measuring spoon for accurate dosage of solid reagents
- Color scale with at least 5 gradations


Fill the sample


Add reagent


Mix


Analyze

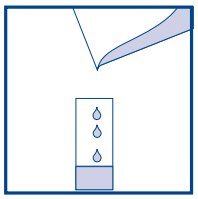
Titration test kits

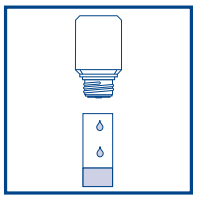
Principle:
Titration with drop counting

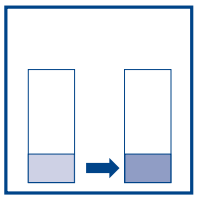
- Visual evaluation
- Environment-friendly
- Cost-efficient
- Convenient handling, as easy as test strips
- Accurate results
- Indicator and titration solution in one dropping bottle
- Handy packages
- With pictogram instructions
- Reagent bottles with clear dosing instructions

Test kit consists of plastic pack with:

- Sample tube with 5 mL ring mark
- One dropping bottle with mixture of indicator and titration solution


Fill the sample


Add reagent


Color change

Count the drops: 1 drop = 1 measuring unit

Test kits for water analysis

VISOCOLOR® ECO

VISOCOLOR® ECO presents a product group of colorimetric and titrimetric test kits which avoids hazardous substances wherever possible. With *VISOCOLOR® ECO* even water constituents with low limiting values can be determined with sufficient accuracy. All *VISOCOLOR® ECO* test kits are packed in an environment-friendly box and contain easy to understand instructions in 6 languages.

Colorimetric test kits

Principle:
Colorimetry with color comparison card

- Visual and photometric evaluation (PF-12)
- Environment-friendly
- Economic
- Convenient handling
- Higher accuracy and sensitivity
- With pictogram instructions
- Reagent bottles with clear dosing instructions
- Compensation of turbidity and colors
- Refill packs available

Test kit consists of cardboard box with:

- 2 measuring tubes 20 mm diameter with screw caps
- Holder for the measuring tubes
- Color coded bottles with liquid or powder reagents
- Graduated plastic syringe 5 mL for convenient sample dosage
- Measuring spoon for accurate dosage of solid reagents
- Color comparison card with at least 5 gradations

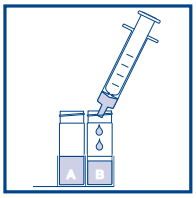
Titration test kits

Principle:
Titration with drop counting

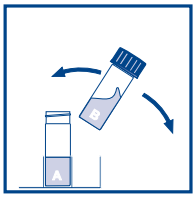
- Visual evaluation
- Environment-friendly
- Economic
- Convenient handling
- Higher accuracy and sensitivity
- Clearer color change due to separated dropping reagents
- Reagent bottles with clear dosing instructions

Test kit consists of cardboard box with:

- Sample tube with 5 mL ring mark
- Graduated plastic syringe 5 mL for convenient sample dosage
- Dropping bottle(s) with indicator solution
- Dropping bottle(s) with titration solution


Fill the sample


Add reagent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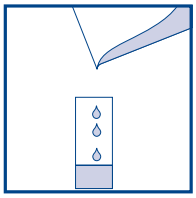
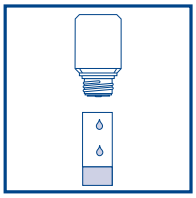
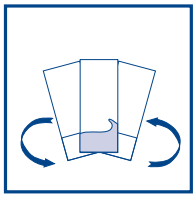
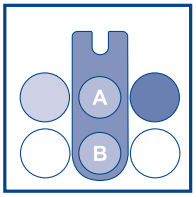

Fill the sample

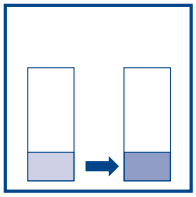

Add indicator


Titration solution


Wait



Analyze


Color change

Test kits for water analysis

VISOCOLOR® *HE*

VISOCOLOR® *HE* test kits are highly sensitive colorimetric test kits. In comparison with conventional *VISOCOLOR*® kits, their sensitivity is enhanced by increasing the length of the test tube and the use of highly sensitive reagents. This technique allows a 10-fold to 100-fold increase in sensitivity. Each *VISOCOLOR*® *HE* test kit is packed in a robust plastic box which contains the comparator block with color comparison disk and all required reagents. The *VISOCOLOR*® titration test kits are based on principles of volumetric analysis. On the gradated syringe the results can be read off in mg/L or in alternative dimensions.

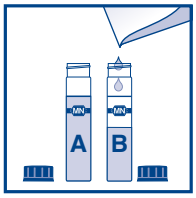
Colorimetric test kits

Principle:
High sensitivity colorimetry with comparator block and color comparison disc

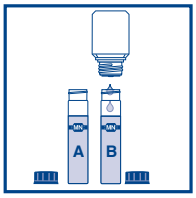
- Visual evaluation
- Environment-friendly
- Convenient handling
- Highest accuracy due to extremely narrow gradation
- Highest sensitivity down to 0.002 mg/L due to longer measuring tubes
- Reagent bottles with clear dosing instructions
- Compensation of turbidity and colors
- Refill packs available

Test kit consists of plastic box with:

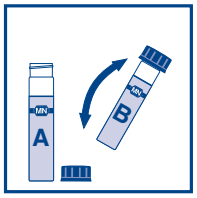
- 2 measuring tubes 20 mm diameter with screw caps
- Comparator block with color comparison disk
- Color coded bottles with liquid or powder reagents
- Measuring spoon for accurate dosage of solid reagents
- Beaker for convenient sample dosage



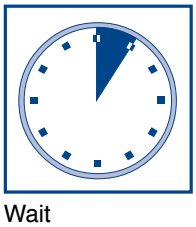
Fill the sample

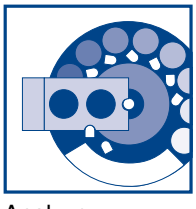


Add reagent



Mix


Wait


Analyze

Titration test kits

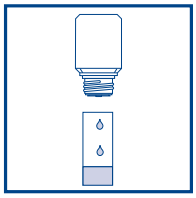
Principle:
High sensitive volumetric analysis with graduated syringe

- Visual evaluation
- Convenient handling
- Highest accuracy due to narrowly graduated syringe
- Reagent bottles with clear dosing instructions
- Clearer color change due to separated dropping reagents
- Refill packs available

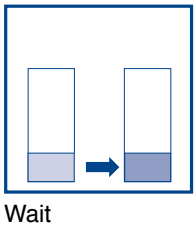
Test kit consists of cardboard box with:

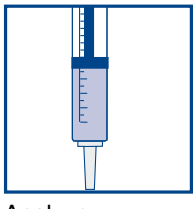
- Sample tube with 5 mL ring mark
- Graduated syringe for precise reagent dosage
- Bottle(s) with indicator solution
- Bottle(s) with titration solution


Fill the sample


Add reagent


Mix


Wait


Analyze

Test kits for water analysis

VISOCOLOR® program

VISOCOLOR® tests kits are complete plastic boxes with all reagents and accessories for a test.
Refill packs are for the replacement of used reagents in a test kit or reagent case. They don't come with a color chart or accessories.

Ordering information

Test	Range	Type	No of tests	REF test kit	REF refill pack
Acidity AC 7 (base capacity)	0.2–7.0 mmol/L H^+ [1]	*HE*	200	**915 006**	**915 206**
Alkalinity AL 7* (total)	0.2–7.0 mmol/L OH^- [1]	*HE*	200	**915 007**	**915 207**
Alkalinity (p/m-Wert) see Carbonate hardness C 20					
Aluminum	0.10–0.50 mg/L Al^{3+}	*ECO*	50	**931 006**	**931 206**
Ammonium 15*	0.5–15 mg/L NH_4^+	*ECO*	50	**931 010**	**931 210**
Ammonium	0.2–3 mg/L NH_4^+	*alpha*	50	**935 012**	–
Ammonium 3*	0.2–3 mg/L NH_4^+	*ECO*	50	**931 008**	**931 208**
Ammonium*	0.02–0.50 mg/L NH_4^+	*HE*	110	**920 006**	**920 106**
Calcium CA 20*	0.6–25.0 °e / 0.1–3.6 mmol/L Ca^{2+} [1]	*HE*	200	**915 010**	**915 210**
Calcium*	1 drop ≙ 5 mg/L Ca^{2+}	*ECO*	100	**931 012**	–
Carbonate hardness	1 drop ≙ 1.25 °e ≙ 17.8 mg/L $CaCO_3$	*alpha*	100	**935 016**	–
Carbonate hardness	1 drop ≙ 1.25 °e ≙ 17.8 mg/L $CaCO_3$	*ECO*	100	**931 014**	–
Carbonate hardness C 20 (p-/m-Wert)	0.6–25.0 °e / 0.2–7.2 mmol/L H^+ [1]	*HE*	200	**915 003**	**915 203**
Chloride*	1–60 mg/L Cl^-	*ECO*	90	**931 018**	**931 218**
Chloride CL 500*	5–500 mg/L Cl^- [1]	*HE*	300	**915 004**	**915 204**
Chlorine, free	0.25–2.0 mg/L Cl_2	*alpha*	150	**935 019**	–
Chlorine 2, free + total	0.1–2.0 mg/L Cl_2	*ECO*	150	**931 015**	**931 215**
free Chlorine 2	0.1–2.0 mg/L Cl_2	*ECO*	150	**931 016**	**931 216**
Chlorine 6, free + total [2]	0.05–6.00 mg/L Cl_2	*ECO*	200	–	**931 217**
free Chlorine 6 [2]	0.05–6.00 mg/L Cl_2	*ECO*	400	–	**931 219**
Chlorine	0.02–0.60 mg/L Cl_2	*HE*	160	**920 015**	**920 115**
Chlorine + pH see Swimming pool					
Chlorine dioxide* NEW!	<0.2–3.8 mg/L ClO_2	*ECO*	150	**931 021**	**931 221**
Chromium(VI)*	0.02–0.50 mg/L Cr(VI)	*ECO*	140	**931 020**	**931 220**
Copper	0.1–1.5 mg/L Cu^{2+}	*ECO*	100	**931 037**	**931 237**
Copper	0.04–0.50 mg/L Cu^{2+}	*HE*	150	**920 050**	**920 150**
Cyanide*	0.01–0.20 mg/L CN^-	*ECO*	100	**931 022**	**931 222**
Cyanide*	0.002–0.04 mg/L CN^-	*HE*	55	**920 028**	**920 128**
Cyanuric acid	10–100 mg/L Cya	*ECO*	100	**931 023**	**931 223**
DEHA (diethylhydroxylamine)	0.01–0.30 mg/L DEHA	*ECO*	125	**931 024**	**931 224**
Fluoride [3]	0.1–2.0 mg/L F^-	*ECO*	150	–	**931 227**
total Hardness*	1 drop ≙ 1.25 °e ≙ 17.8 mg/L $CaCO_3$	*alpha*	100	**935 042**	–
total Hardness	1 drop ≙ 1.25 °e ≙ 17.8 mg/L $CaCO_3$	*ECO*	110	**931 029**	–
total Hardness H 20 F	0.6–25.0 °e / 0.1–3.6 mmol/L Ca^{2+} [1]	*HE*	200	**915 005**	**915 205**
total Hardness H 2*	0.05–2.00 °d / 0.01–0.36 mmol/L Ca^{2+} [1]	*HE*	200	**915 002**	**915 202**
residual Hardness *	0.04–0.30 °d	*alpha*	200	**935 080**	–
Hydrazine*	0.05–0.40 mg/L N_2H_4	*ECO*	130	**931 030**	**931 230**
Iron 1* NEW!	0.04–1.0 mg/L Fe	*ECO*	200	**931 025**	**931 225**
Iron 2	0.04–1.0 mg/L Fe	*ECO*	100	**931 026**	**931 226**
Iron	0.01–0.20 mg/L Fe	*HE*	300	**920 040**	**920 140**
Manganese*	0.1–1.5 mg/L Mn	*ECO*	70	**931 038**	**931 238**
Manganese*	0.03–0.50 mg/L Mn	*HE*	100	**920 055**	**920 155**

[1] For titration test kits the range can be increased with additional reagent syringe.
[2] only for the photometric determination with PF-11, PF-12 and *VISOCOLOR*® photino
[3] only for the photometric determination with PF-11 and PF-12
[4] based on the chemical procedures of the German Standard Methods (DEV)

* This product contains harmful substances which must be specially labeled as hazardous. For detailed information please see MSDS.

Test kits for water analysis

VISOCOLOR® program

Test	Range	Type	No of tests	REF test kit	REF refill pack
Nickel*	0.1–1.5 mg/L Ni^{2+}	*ECO*	150	**931 040**	**931 240**
Nitrate*	2–50 mg/L NO_3^-	*alpha*	100	**935 065**	**–**
Nitrate*	1–120 mg/L NO_3^-	*ECO*	110	**931 041**	**931 241**
Nitrite*	0.05–1.0 mg/L NO_2^-	*alpha*	200	**935 066**	**–**
Nitrite	0.02–0.5 mg/L NO_2^-	*ECO*	120	**931 044**	**931 244**
Nitrite	0.005–0.10 mg/L NO_2^-	*HE*	150	**920 063**	**920 163**
pH 5–9*	pH 5.0–9.0	*alpha*	200	**935 075**	**–**
pH 4.0–9.0	pH 4.0–9.0	*ECO*	450	**931 066**	**931 266**
pH 4.0–10.0	pH 4.0–10.0	*HE*	500	**920 074**	**920 174**
pH 6.0–8.2 [2]	pH 6.0–8.2	*ECO*	150	**–**	**931 270**
Phosphate*	2–20 mg/L PO_4^{3-}	*alpha*	70	**935 079**	**–**
Phosphate*	0.2–5 mg/L P	*ECO*	80	**931 084**	**931 284**
Phosphate*	0.05–1.0 mg/L P	*HE*	300	**920 082**	**920 182**
Phosphate* (DEV) [4]	0.01–0.25 mg/L P	*HE*	100	**920 080**	**920 180**
Potassium*	2–15 mg/L K^+	*ECO*	60	**931 032**	**931 232**
Residual hardness see Hardness (residual)					
Oxygen*	1–10 mg/L O_2	*ECO*	50	**931 088**	**931 288**
Oxygen SA 10*	0.2–10 mg/L O_2 [1]	*HE*	100	**915 009**	**915 209**
Silica / silicon	0.2–3.0 mg/L SiO_2	*ECO*	80	**931 033**	**931 233**
Silica* / silicon	0.01–0.30 mg/L Si	*HE*	120	**920 087**	**920 187**
Sulfate*	25–200 mg/L SO_4^{2-}	*ECO*	100	**931 092**	**931 292**
Sulfide*	0.1–0.8 mg/L S^{2-}	*ECO*	90	**931 094**	**931 294**
Sulfite	1 drop ≙ 1 mg/L SO_3^{2-}	*ECO*	60	**931 095**	**–**
Sulfite SU 100*	2–100 mg/L SO_3^{2-} [1]	*HE*	100	**915 008**	**915 208**
Swimming pool (Chlorine + pH)	0.1–2.0 mg/L Cl_2 pH 6.9–8.2	*ECO*	150 150	**931 090**	**931 290**
Zinc	0.5–3 mg/L Zn^{2+}	*ECO*	120	**931 098**	**931 298**

[1] For titration test kits the range can be increased with additional reagent syringe.
[2] only for the photometric determination with PF-11, PF-12 and *VISOCOLOR*® photino
[3] only for the photometric determination with PF-11 and PF-12
[4] based on the chemical procedures of the German Standard Methods (DEV)

* This product contains harmful substances which must be specially labeled as hazardous. For detailed information please see MSDS.

Test kits for water analysis

Analytical principles

Colorimetry

In colorimetric procedures advantage is taken of the fact that certain reagents form colored compounds with the substances to be determined. The intensity of the color is directly related to the concentration of the substance in question. For example in the case of the *VISOCOLOR*® Nitrite, the reagents form a blue-red dye with nitrite. The resulting color intensity is proportional to the concentration of nitrite. In the case of pH measurements the use of specific indicator mixtures permits the formation of a characteristic color for each pH value. The reaction colors obtained are compared with a range of standards in a sample vessel called comparator. As soon as the reaction color has been matched to a comparison color, the result can be read from the comparator or color charts.

Volumetric analysis (titration)

For certain substances it is difficult or even impossible to convert them to compounds which can be colorimetrically evaluated. In many of these cases titrimetric methods are used for analysis. This measuring principle is bases on the following idea: In volumetric analysis, individual drops of a titration solution are added to a defined volume of sample solution. The active substance in the titration solution reacts with the substance to be determined in the sample. After complete reaction further addition of titration solution would cause an excess of the active substance. The point of complete reaction (end point or equivalence point) is visualized by the color change of an indicator added to the sample.

Description of individual parameters and tests

Acidity

H^+

In natural unpolluted waters mainly carbonic acid but also humic acids are present. With this test kit, all acids, i. e. also those present in industrial waters, can be determined.

Reaction basis:
Titrimetric determination of acids with sodium hydroxide solution against the p-indicator (Reaction basis according to DIN 38409-H7).

Note:
To differentiate between mineral acids and carbonic acid, the sample should be titrated against the m-indicator from the test kit *VISOCOLOR*® *HE* Carbonate hardness C 20.

***VISOCOLOR*® *HE* Acidity AC 7**	**REF 915 006**
Refill pack	**REF 915 206**
Type:	titration test kit
Range:	0.2–7.0 mmol/L H^+ 1 gradation mark = 0.2 mmol/L H^+
Sufficient for:	about 200 tests with an average acid content of 4 mmol/L H^+
Shelf life:	at least 2 years
Sea water suitability:	yes

Alkalinity (total)

OH^-

All compounds which cause a pH increase above pH 7 are determined, e.g. hydroxide, carbonate, hydrogen carbonate etc.

Reaction basis:
Titrimetric alkalinity determination with hydrochloric acid against the m-indicator (Reaction basis according to DIN 38409-H7).

Note:
To differentiate between hydroxide, carbonate and hydrogen carbonate you should use the test kit *VISOCOLOR*® *HE* Carbonate hardness C 20 (see German Standard Methods DIN 38 409-H7).

***VISOCOLOR*® *HE* Alkalinity AL 7**	**REF 915 007**
Refill pack	**REF 915 207**
Type:	titration test kit
Range:	0.2–7.0 mmol/L OH^- 1 gradation mark = 0.2 mmol/L OH^-
Sufficient for:	about 200 tests with an average acid content of 4 mmol/L OH^-
Shelf life:	at least 2 years
Sea water suitability:	yes

Aluminum

Al^{3+}

Aluminum is the most common metal in our anthroposphere and behind oxygen and silica the most common element of the earth's crust. Because of its big affinity to oxygen, aluminum does not exist in elemental form in nature, but in different oxidized compounds.

For drinking water, the WHO recommends a threshold value of 0.2 mg/L Al^{3+}. In accordance to the EU council guideline 98/83/EEC, the threshold value for drinking water is 0.2 mg/L Al^{3+}. In natural waters, the concentration of aluminum compounds is usually low, but waste water can contain aluminum in higher concentrations, e.g. at electroplating companies or paper mills. Different national regulations tolerate 2–3 mg/L Al^{3+} in effluents from various industries (metal, electroplating and printing industries).

Reaction basis:
Colorimetric determination with chromazurol S.

***VISOCOLOR*® *ECO* Aluminum**	**REF 931 006**
Refill pack	**REF 931 206**
Type:	colorimetric test kit
Range:	0 · 0.10 · 0.15 · 0.20 · 0.25 · 0.30 · 0.40 · 0.50 mg/L Al^{3+}
Sufficient for:	50 tests
Shelf life:	at least 2 years
Sea water suitability:	yes, after dilution (1+9)

Ammonium

NH_4^+

Ammonium ions occur primarily in domestic waste waters, but frequently also in industrial waste waters. In surface and ground waters, ammonium ions indicate decomposition of animal or vegetable matter. Control of the ammonium values is therefore important to the water supply, as a contamination indicator.

Reaction basis:
DEV procedure: in alkaline medium ammonium ions react with chlorine to form chloroamines which in the presence of a catalyst form a blue colored indophenol with phenols (Reaction basis according to DIN 38406-E5).

Primary amines react like ammonium ions resulting in high results.

Chlorine-consuming substances can lower the result or even inhibit the reaction depending on their concentration.

***VISOCOLOR*® *alpha* Ammonium** **REF 935 012**

Type:	colorimetric test kit
Range:	0 · 0.2 · 0.5 · 1 · 2 · 3 mg/L NH_4^+
Sufficient for:	50 tests
Shelf life:	at least 1.5 years
Sea water suitability:	yes, after dilution (1+9)

***VISOCOLOR*® *ECO* Ammonium 15** **REF 931 010**
Refill pack **REF 931 210**

Type:	colorimetric test kit
Range:	0 · 0.5 · 1 · 2 · 3 · 5 · 7 · 10 · 15 mg/L NH_4^+
Sufficient for:	50 tests
Shelf life:	at least 1.5 years
Sea water suitability:	yes, after dilution (1+9)

***VISOCOLOR*® *ECO* Ammonium 3** **REF 931 008**
Refill pack **REF 931 208**

Type:	colorimetric test kit
Range:	0 · 0.2 · 0.3 · 0.5 · 0.7 · 1 · 2 · 3 mg/L NH_4^+
Sufficient for:	50 tests
Shelf life:	at least 1.5 years
Sea water suitability:	yes, after dilution (1+9)

***VISOCOLOR*® *HE* Ammonium** **REF 920 006**
Refill pack **REF 920 106**

Type:	highly sensitive test kit
Range:	0.0 · 0.02 · 0.04 · 0.07 · 0.10 · 0.15 · 0.20 · 0.30 · 0.40 · 0.50 mg/L NH_4^+
Sufficient for:	110 tests
Shelf life:	at least 1 year
Sea water suitability:	no

Bromine

Br_2

Bromine and brominating reagents such as 1,3-dibromo-5,5-dimethylhydantoin (DBH) are used – like chlorine – for disinfecting swimming pool water. For determination of bromine you may use all *VISOCOLOR*® Chlorine tests (see page 59). A factor for conversion is provided in the instructions.

Calcium

Ca^{2+}

Calcium is widely distributed in nature in rocks and in water. Water containing calcium and magnesium causes problems in industry as well as in households, since during boiling calcium carbonate precipitate as detrimental boiler scale. Additionally, calcium ions inhibit soap foaming.

Reaction basis:
Complexometric titration after precipitation of the magnesium salts (Reaction basis according to DIN 38406-E3).

***VISOCOLOR*® *ECO* Calcium** **REF 931 012**

Type:	titration test kit
Range:	1 drop = 5 mg/L Ca^{2+}
Sufficient for:	about 100 tests with an average calcium concentration of 50 mg/L Ca^{2+}
Shelf life:	at least 1.5 years
Sea water suitability:	yes, after dilution (1+4)

***VISOCOLOR*® *HE* Calcium CA 20** **REF 915 010**
Refill pack **REF 915 210**

Type:	titration test kit
Range:	0.6–25.0 °e or 0.1–3.6 mmol/L Ca^{2+}
Sufficient for:	about 200 tests with an average calcium hardness of 12.5 °e or 1.8 mmol/L Ca^{2+}
Shelf life:	at least 2 years
Sea water suitability:	yes, after dilution (1+4)

Carbonate hardness

CO_3^{2-}

Carbonate hardness is the part of calcium and magnesium ions which are present as carbonate or hydrogen carbonate.

Reaction basis:
The determination is preformed as titration with hydrochloric acid against a mixed indicator, which changes color at pH 4.5 (Reaction basis according to DIN EN ISO 9963-1 C24).

Normally the carbonate hardness is smaller than the total hardness. If the carbonate hardness is larger than the total hardness, you should trace the origin of this abnormal conditions, e.g. discharge of alkali hydrogen carbonates or high buffer capacity.

VISOCOLOR® _alpha_ Carbonate hardness **REF 935 016**

Type:	titration test kit
Range:	1 drop ≙ 1.25 °e ≙ 17.8 mg/L $CaCO_3$
Sufficient for:	about 100 tests with an average hardness of 12.5 °e
Shelf life:	at least 1.5 years
Sea water suitability:	yes

VISOCOLOR® _ECO_ Carbonate hardness **REF 931 014**

Type:	titration test kit
Range:	1 drop ≙ 1.25 °e ≙ 17.8 mg/L $CaCO_3$
Sufficient for:	about 100 tests with an average hardness of 12.5 °e
Shelf life:	at least 2 years
Sea water suitability:	yes

VISOCOLOR® _HE_ Carbonate hardness C 20
REF 915 003
Refill pack **REF 915 203**

Type:	titration test kit
Range:	0.6–25.0 °e or 0.2–7.0 mmol/L H^+
Sufficient for:	about 200 tests with an average hardness of 12.5 °e or 3.6 mmol/L H^+
Shelf life:	at least 2 years
Sea water suitability:	yes

With this test kit you can also determine the partial alkalinity (p-value) in addition to the carbonate hardness (m-value).

Carbonic acid

CO_2

Carbonic acid is a natural component of water acidity. Determination is performed with the test kit *VISOCOLOR®* Acidity AC 7 (see page 56).

Chloride

Cl^-

Chloride ions occur in all natural waters. Their concentration depends on geological and regional factors. In waste waters and polluted rivers, chloride concentrations can reach high values.

Reaction bases:
(a) Mercurimetric titration

(b) Mercury(II) thiocyanate method

VISOCOLOR® _ECO_ Chloride **REF 931 018**
Refill pack **REF 931 218**

Type:	colorimetric test kit
Range:	1 · 2 · 4 · 7 · 12 · 20 · 40 · 60 mg/L Cl^-
Reaction basis:	(b) Mercury(II) thiocyanate method
Sufficient for:	90 tests
Shelf life:	at least 1 year
Sea water suitability:	no

VISOCOLOR® _HE_ Chloride CL 500 **REF 915 004**
Refill pack **REF 915 204**

Type:	titration test kit
Range:	5–500 mg/L Cl^- 1 gradation mark = 5 mg/L Cl^-
Reaction basis:	(a) Mercurimetric titration
Sufficient for:	about 300 tests with an average chloride ion concentration of 200 mg/L Cl^-
Shelf life:	at least 2 years
Sea water suitability:	yes, after dilution (1:50)

Chlorine

Cl_2

The addition of chlorine to swimming pools, water reservoirs and water mains is an approved procedure to rid the water of germs. With the correct dose harmful microorganisms are destroyed, many impurities removed and the growth of algae is prevented. However it is imperative that the chlorine content is regularly checked, since excessive chlorine not only impairs the smell and taste of the water but can be hazardous. One distinguishes between free chlorine and bound chlorine (chloroamines); the sum of both is called total chlorine.

Reaction basis:
At a pH value of 5–6 free chlorine reacts with *N,N*-diethyl-1,4-phenylene diamine (DPD) to form a red-violet dye. In the presence of iodide ions the content of total chlorine can be determined, too. (Reaction basis according to DIN ISO 7393 G4-2).

The determination of free chlorine includes the concentrations of bromine, bromoamine, chloroamine, iodine and in part chlorine dioxide.

1.0 mg/L Cl_2 ≙ 2.3 mg/L Br_2 ≙ 3.6 mg/L I_2

Higher-valency manganese compounds simulate free chlorine.

Note:
When measuring the chlorine content in swimming pools it is recommended to check the pH value as well. For this purpose we supply combination test kits *VISOCOLOR® ECO* Swimming pool (page 69).

VISOCOLOR® alpha Chlorine, free — REF 935 019

Type:	colorimetric test kit
Range:	0.25 · 0.5 · 1.0 · 1.5 · 2.0 mg/L Cl_2
Sufficient for:	150 tests
Shelf life:	at least 1.5 years
Sea water suitability:	yes

VISOCOLOR® ECO Chlorine 2, free + total — REF 931 015
Refill pack — REF 931 215

Type:	colorimetric test kit
Range:	< 0.1 · 0.1 · 0.2 · 0.3 · 0.4 · 0.6 · 0.9 · 1.2 · 2.0 mg/L Cl_2
Sufficient for:	150 tests
Shelf life:	at least 1.5 years
Sea water suitability:	yes

VISOCOLOR® ECO free Chlorine 2 — REF 931 016
Refill pack — REF 931 216

Type:	colorimetric test kit
Range:	< 0.1 · 0.1 · 0.2 · 0.3 · 0.4 · 0.6 · 0.9 · 1.2 · 2.0 mg/L Cl_2
Sufficient for:	150 tests
Shelf life:	at least 1.5 years
Sea water suitability:	yes

VISOCOLOR® ECO Chlorine 6, free + total — REF 931 217

Type:	reagent set for photometric determination
Range:	0.05–6.00 mg/L Cl_2
Sufficient for:	200 tests
Shelf life:	at least 2 years
Sea water suitability:	yes

A visual determination is not possible.

VISOCOLOR® ECO free Chlorine 6 — REF 931 219

Type:	reagent set for photometric determination
Range:	0.05–6.00 mg/L Cl_2
Sufficient for:	400 tests
Shelf life:	at least 2 years
Sea water suitability:	yes

A visual determination is not possible.

VISOCOLOR® HE Chlorine — REF 920 015
Refill pack — REF 920 115

Type:	highly sensitive test kit
Range:	0.0 · 0.02 · 0.04 · 0.06 · 0.10 · 0.15 · 0.20 · 0.30 · 0.40 · 0.60 mg/L Cl_2
Sufficient for:	160 tests
Shelf life:	at least 2 years
Sea water suitability:	yes

Test kits for water analysis

Description of individual parameters and tests

Chlorine dioxide

NEW!

ClO_2

Chlorine dioxide is being used as a universal disinfecting reagent, replacing chlorine especially in drinking and swimming pool water processing. Not only does it possess a significantly higher oxidizing power than chlorine but moreover, the formation of toxic THMs (trihalomethanes) is avoided when using chlorine dioxide as the oxidizing agent.

Reaction basis:
Chlorine dioxide reacts, like chlorine, with DPD (*N,N*-diethyl-1,4-phenylenediamine) at a pH value of 5–6 to form a red-violet dye. An additional step makes this test kit even suitable for the determination of chlorine dioxide in presence of chlorine.

***VISOCOLOR® ECO* Chlorine dioxide**	**REF 931 021**
Refill pack	**REF 931 221**
Type:	colorimetric test kit
Range:	<0.2 · 0.2 · 0.4 · 0.6 · 0.8 · 1.1 · 1.7 · 2.3 · 3.8 mg/L ClO_2
Sufficient for:	150 tests
Shelf life:	at least 1.5 years
Sea water suitability:	no

Chromate

CrO_4^{2-}

Chromium compounds can be present in industrial waste waters in trivalent form [chromium(III) ions] and in hexavalent form (chromate and dichromate ions). In order to determine the total chromium all other valencies must be oxidized to chromium(VI). Each test kit is equipped with a detailed description.

Reaction basis:
In sulfuric acid chromate ions react with diphenylcarbazide to form a red-violet dye. (Reaction basis according to DIN EN ISO 7393 G4-2).

***VISOCOLOR® ECO* Chromium(VI)**	**REF 931 020**
Refill pack	**REF 931 220**
Type:	colorimetric test kit
Range:	0.02 · 0.05 · 0.10 · 0.15 · 0.20 · 0.30 · 0.40 · 0.50 mg/L Cr(VI)
Sufficient for:	140 tests
Shelf life:	at least 1.5 years
Sea water suitability:	yes

Copper

Cu^{2+}

In water, copper(II) can be found in dissolved as well as in undissolved form. Copper(I) compounds and undissolved copper(II) compounds are not determined unless they are decomposed with concentrated nitric acid prior to the test.

Reaction basis:
In weakly alkaline medium copper(II) ions react with cuprizone forming a blue color complex.

***VISOCOLOR® ECO* Copper**	**REF 931 037**
Refill pack	**REF 931 237**
Type:	colorimetric test kit
Range:	0 · 0.1 · 0.2 · 0.3 · 0.5 · 0.7 · 1.0 · 1.5 mg/L Cu^{2+}
Sufficient for:	100 tests
Shelf life:	at least 2 years
Sea water suitability:	yes

***VISOCOLOR® HE* Copper**	**REF 920 050**
Refill pack	**REF 920 150**
Type:	highly sensitive test kit
Range:	0.0 · 0.04 · 0.07 · 0.10 · 0.15 · 0.20 · 0.25 · 0.30 · 0.40 · 0.50 mg/L Cu^{2+}
Sufficient for:	100 tests
Shelf life:	at least 2 years
Sea water suitability:	yes

Cyanide

CN⁻

Cyanide ions are very toxic because they block the iron of the respiratory enzyme and thus inhibit oxygen transport. For humans 1 mg cyanide per kg body weight is considered lethal.

Reaction basis:
Cyanide ions react with chlorine to form cyanogen chloride, which then opens a pyridine ring to form glutaconedialdehyde. By aldol condensation with barbituric acid, a violet polymethine dye is produced.

This test detects free cyanide and cyanide complexes which can be destroyed with chlorine. If interfering substances like heavy metal complexes, thiocyanate, sulfide, dyes or aromatic amines are present, a distillation according to DIN 38 405-D 13–2–2 must precede the cyanide test.

For the determination of easily released and total cyanide as well as for the determination of cyanide in stone fruit spirits, please contact MACHEREY-NAGEL for special instructions.

***VISOCOLOR*® *ECO* Cyanide** **REF 931 022**
Refill pack **REF 931 222**

Type:	colorimetric test kit
Range:	0 · 0.01 · 0.02 · 0.03 · 0.05 · 0.07 · 0.10 · 0.15 · 0.20 mg/L CN^-
Sufficient for:	100 tests
Shelf life:	at least 1 year
Sea water suitability:	yes, after dilution (1+3)

***VISOCOLOR*® *HE* Cyanide** **REF 920 028**
Refill pack **REF 920 128**

Type:	highly sensitive test kit
Range:	0.0 · 0.002 · 0.004 · 0.007 · 0.010 · 0.015 · 0.020 · 0.025 · 0.030 · 0.040 mg/L CN^-
Sufficient for:	55 tests
Shelf life:	at least 1 year
Sea water suitability:	yes

Cyanuric acid

Cya

Chlorine for disinfection in swimming pools is degraded by intensive UV radiation. A common stabilizer for chlorine in swimming pools is cyanuric acid. Chloroisocyanic acid is also used directly as a disinfecting agent. Due to legal regulations, as good and careful pool managers, many private and public owners use rapid tests for frequent monitoring of cyanuric acid.

Reaction basis:
Turbidity measurement

Cyanuric acid forms a fine precipitate with a triazine derivative.

The turbidity caused by this reaction can be measured visually or photometrically to determine the cyanuric acid concentration.

Turbidities interfere and must be filtered prior to the analysis.

***VISOCOLOR*® *ECO* Cyanuric acid** **REF 931 023**
Refill pack **REF 931 223**

Type:	colorimetric test kit
Range:	10 · 15 · 20 · 30 · 40 · 60 · 80 · 100 mg/L Cya
Sufficient for:	100 tests
Shelf life:	at least 1.5 years
Sea water suitability:	yes

DEHA (Diethylhydroxylamine)

DEHA

In boiler feed water treatments, the carcinogenic hydrazine is more and more replaced by diethylhydroxylamine (DEHA) to remove oxygen.

Reaction basis:
Measurement of the reduction properties of DEHA for iron(III) ions and determination of the iron(II) ions formed. Strictly observe the temperature and reaction time since they strongly influence the color intensity.

Iron(II) ions interfere. Modified test procedure eliminate this source of error.

***VISOCOLOR*® *ECO* DEHA** **REF 931 024**

Refill pack **REF 931 224**

Type:	colorimetric test kit
Range:	0 · 0.01 · 0.03 · 0.05 · 0.10 · 0.15 · 0.20 · 0.25 · 0.30 mg/L DEHA
Sufficient for:	125 tests
Shelf life:	at least 1 year
Sea water suitability:	yes

Dithionite

$S_2O_4^{2-}$

Dithionites ($S_2O_4^{2-}$), above all sodium dithionite (so-called hydrosulfite), are important aids in dyeing, textile and paper industries due to their reducing properties. They are especially used for vat dyeing, for bleaching of wood-based paper, sugar, sirup, gelatine, starche, molasses, saccharine juice, soap, technical fats, as decolorant for textiles, for desilvering of used fixing baths etc. Dithionite can be determined using a special method with *VISOCOLOR*® Sulfite SU 100. Please contact MACHEREY-NAGEL for special instructions.

Fluoride

F^-

Normally, the content of fluoride in surface and ground water is lower than 1 mg/L. Permanent consumption of water containing more than 2 mg/L fluoride can cause a drinking water fluorese (a stained discoloration of the tooth enamel). On the other hand a content of fluoride lower than 0.5 mg/L could lead to an increased cavity risk. The optimal content of fluoride in drinking water is about 1 mg/L. To avoid cavity problems, in some countries the content of fluoride in drinking water is increased artificially. However, WHO and EC drinking water regulations recommend a threshold value of 1.5 mg/L F^-.

In some European countries, the threshold value for mineral water is also 1.5 mg/L F^-. For water used in the preparation of baby food a threshold value of 0.7 mg/L F^- is recommended. Natural mineral waters with a fluoride content of more than 5 mg/L must be labelled with a warning.

Reaction basis:
Photometric determination of fluoride with 1,8-dihydroxy-2-(4-sulfophenylazo)naphthalene-3,6-disulfonic acid (SPADNS) with the photometer PF-12.

***VISOCOLOR*® *ECO* Fluoride** **REF 931 227**

Type:	reagent set for photometric determination
Range:	0.1–2.0 mg/L F^-
Sufficient for:	150 tests
Shelf life:	at least 1.5 years
Sea water suitability:	yes, after distillation

A visual determination is not possible

Hardness (total and residual)

°e

The total hardness of water is based on its content of alkaline earth ions (calcium and magnesium ions). This content depends on the geological conditions and may vary considerably. Knowledge of the total hardness is important for the use of water in industrial as well as municipal applications, e.g. in the household as wash water or as boiler feed water in industry.

Reaction bases:
(a) Complexometric titration
in accordance with DIN 38406 E3 and DIN 38409 H6.

(b) Colorimetry with a mixed indicator
Copper(II) ions can delay or (in higher concentrations) even block the color change of the indicator. For this reason allow enough water to run through copper pipes prior to sampling.

***VISOCOLOR*® *alpha* total Hardness** **REF 935 042**

Type:	titration test kit
Range:	1 drop ≙ 1.25 °e ≙ 17.8 mg/L $CaCO_3$
Reaction basis:	(a) titration
Sufficient for:	100 tests with an average hardness of 12.5 °e
Shelf life:	at least 1.5 years
Sea water suitability:	yes, after dilution (1:30)

***VISOCOLOR*® *ECO* total Hardness** **REF 931 029**

Type:	titration test kit
Range:	1 drop ≙ 1.25 °e ≙ 17.8 mg/L $CaCO_3$
Reaction basis:	(a) titration
Sufficient for:	110 tests with an average hardness of 12.5 °e
Shelf life:	at least 1.5 years
Sea water suitability:	yes, after dilution (1:30)

***VISOCOLOR*® *HE* total Hardness H 20 F** **REF 915 005**
Refill pack **REF 915 205**

Type:	titration test kit
Range:	0.6–25.0 °e or 0.1–3.6 mmol/L Ca^{2+} 1 gradation mark = 0.5 °d = 0.1 mmol/L Ca^{2+}
Reaction basis:	(a) titration
Sufficient for:	about 200 tests with an average hardness of 12.5 °e or 1.8 mmol/L Ca^{2+}
Shelf life:	at least 1.5 years
Sea water suitability:	yes, after dilution (1:30)

VISOCOLOR® alpha residual Hardness **REF 935 080**

Type:	colorimetric test kit
Range:	0.00 · 0.05 · 0.10 · 019 · 0.38 °e
Reaction basis:	(b) colorimetry
Sufficient for:	200 tests
Shelf life:	at least 1 year
Sea water suitability:	no

VISOCOLOR® HE Hardness H 2 **REF 915 002**
Refill pack **REF 915 202**

Type:	titration test kit
Range:	0.06–2.50 °e or 0.01–0.36 mmol/L Ca^{2+} 1 gradation mark = 0.06 °e or 0.01 mmol/L Ca^{2+}
Reaction basis:	(a) titration
Sufficient for:	200 tests with an average hardness of 1.25 °e or 0.18 mmol/L Ca^{2+}
Shelf life:	at least 1.5 years
Sea water suitability:	no

VISOCOLOR® ECO additive reagent Z-1 **REF 931 929**
to eliminate copper ions during determination of total hardness

Hydrazine

N_2H_4

Hydrazine is used to destroy residual oxygen in boiler feed water and condensate water, for example in power plants, to avoid corrosion of the boiler casing. Reaction products are merely nitrogen gas and water, thus the salt load of the water is kept low.

Because of its highly reactive properties, hydrazine is also used as fuel in aviation and astronautics.

Hydrazine is toxic and has a highly toxic effect on water organisms. Hydrazine can be absorbed through the skin. Therefore, water and waste water with potential content of hydrazine must be monitored and tested.

Reaction basis:
DIN method: In acidic solution hydrazine reacts with 4-dimethylaminobenzaldehyde to form a yellow/orange colored compound (Reaction basis according to DIN 38413-P1).

VISOCOLOR® ECO Hydrazine **REF 931 030**
Refill pack **REF 931 230**

Type:	titration test kit
Range:	0 · 0.05 · 0.10 · 0.15 · 0.20 · 0.25 · 0.30 · 0.40 mg/L N_2H_4
Sufficient for:	130 tests
Shelf life:	at least 1 year
Sea water suitability:	yes

Hydrosulfite

$S_2O_4^{2-}$

see Dithionite, page 62

Iron

Fe

Natural waters as well as waste waters often contain some iron. It can be present as Fe(II) or Fe(III) ions if the pH value of the water is below 3 or if the water is free of oxygen. At higher pH values Fe(III) forms an insoluble oxyhydrate. Frequently the sample is in a transition state with finely dispersed iron oxides. In waste water and natural water containing humic acids iron is often present in the form of a complex salt. The *VISOCOLOR*® test kits only determine iron which is present in dissolved form as Fe^{2+} or Fe^{3+} ions. Iron complexes are not covered unless they are decomposed by oxidation with nitric acid and sulfuric acid.

Reaction basis:
Triazin-Methode: iron(II) ions react with a triazine derivative to form a violet complex. Iron(III) ions are reduced and thus also determined.

VISOCOLOR® ECO Iron 1 NEW! **REF 931 025**
Refill pack **REF 931 225**

Type:	colorimetric test kit
Range:	0 · 0.04 · 0.07 · 0.10 · 0.15 · 0.20 · 0.30 · 0.50 · 1.0 mg/L Fe
Sufficient for:	200 tests
Shelf life:	at least 2 years
Sea water suitability:	yes

VISOCOLOR® ECO Iron 2 **REF 931 026**
Refill pack **REF 931 226**

Type:	colorimetric test kit
Range:	0 · 0.04 · 0.07 · 0.10 · 0.15 · 0.20 · 0.30 · 0.50 · 1.0 mg/L Fe
Sufficient for:	100 tests
Shelf life:	at least 2 years
Sea water suitability:	yes

VISOCOLOR® HE Iron **REF 920 040**
Refill pack **REF 920 140**

Type:	highly sensitive test kit
Range:	0.0 · 0.01 · 0.02 · 0.03 · 0.04 · 0.05 · 0.07 · 0.10 · 0.15 · 0.20 mg/L Fe
Sufficient for:	300 tests
Shelf life:	at least 2 years
Sea water suitability:	no

Magnesium

Mg^{2+}

In order to differentiate between the hardness constituents calcium and magnesium one can determine the total hardness (see hardness, page 62) and the calcium hardness (see calcium, page 57). The difference of both is the magnesium content – an important parameter in food and building industries.

Manganese

Mn

Natural waters contain manganese in the divalent, soluble form as well as in colloidal tri- and tetravalent states. Valencies are interchangeable due to oxidation-reduction reactions taking place in the water. The test procedure determines all oxidation states of manganese.

Reaction basis:
In alkaline solution manganese ions react with formaldoxime to form an orange-red complex. (Reaction basis according to DIN 38406-E2).

***VISOCOLOR*® *ECO* Manganese** **REF 931 038**
Refill pack **REF 931 238**

Type:	colorimetric test kit
Range:	0 · 0.1 · 0.2 · 0.3 · 0.5 · 0.7 · 0.9 · 1.2 · 1.5 mg/L Mn
Sufficient for:	70 tests
Shelf life:	at least 1.5 years
Sea water suitability:	yes

***VISOCOLOR*® *HE* Manganese** **REF 920 055**
Refill pack **REF 920 155**

Type:	highly sensitive test kit
Range:	0.0 · 0.03 · 0.06 · 0.10 · 0.15 · 0.20 · 0.25 · 0.30 · 0.40 · 0.50 mg/L Mn
Sufficient for:	100 tests
Shelf life:	at least 1.5 years
Sea water suitability:	no

Nickel

Ni^{2+}

Nickel can be present in industrial waste water. It occurs as the divalent ion or as a nickel complex.

Reaction basis:
In ammonia solution nickel ions react with diacetyldioxime after oxidation with bromine to form a reddish-brown dye. Insoluble nickel compounds (e.g. nickel cyanide, nickel carbonate) and the nickel cyano complexes are not determined.

***VISOCOLOR*® *ECO* Nickel** **REF 931 040**
Refill pack **REF 931 240**

Type:	colorimetric test kit
Range:	0 · 0.1 · 0.2 · 0.3 · 0.5 · 0.7 · 0.9 · 1.2 · 1.5 mg/L Ni^{2+}
Sufficient for:	150 tests
Shelf life:	at least 1.5 years
Sea water suitability:	yes, after dilution (1+9)

Nitrate

NO_3^-

Nitrates occur in most ground and surface waters in concentrations of up to 20 mg/L. In addition to mere geological influences, nitrate concentrations can also increase due to agricultural sources (fertilisers). The *VISOCOLOR*® test kits are intended for the determination of nitrate in surface and drinking water and in industrial waste waters which do not contain high concentrations of interfering ions.

Reaction basis:
Nitrate is reduced to nitrite with an inorganic reducing agent. Nitrite is then diazotised with an aromatic amine and simultaneously coupled to form an azo dye.

***VISOCOLOR*® *alpha* Nitrate** **REF 935 065**

Type:	colorimetric test kit
Range:	2 · 8 · 15 · 30 · 50 mg/L NO_3^-
Sufficient for:	100 tests
Shelf life:	at least 1.5 years
Sea water suitability:	yes

***VISOCOLOR*® *ECO* Nitrate** **REF 931 041**
Refill pack **REF 931 241**

Type:	colorimetric test kit
Range:	0 · 1 · 3 · 5 · 10 · 20 · 30 · 50 · 70 · 90 · 120 mg/L NO_3^-
Sufficient for:	110 tests
Shelf life:	at least 1.5 years
Sea water suitability:	yes

Nitrite

NO_2^-

In surface waters nitrite ions are generally present in low concentrations. Their presence in ground water is less common. In waste waters nitrite frequently occurs, even in fairly high concentrations.

Reaction basis:
Sulfanilamide / sulfanilic acid is diazotized by nitrite in acidic solution. The diazonium salt is coupled with a naphthylamine to form an intensively colored azo dye.

***VISOCOLOR® alpha* Nitrite**	**REF 935 066**
Type:	colorimetric test kit
Range:	0.05 · 0.10 · 0.25 · 0.5 · 1.0 mg/L NO_2^-
Sufficient for:	200 tests
Shelf life:	at least 1.5 years
Sea water suitability:	yes

***VISOCOLOR® ECO* Nitrite**	**REF 931 044**
Refill pack	**REF 931 244**
Type:	colorimetric test kit
Range:	0 · 0.02 · 0.03 · 0.05 · 0.07 · 0.1 · 0.2 · 0.3 · 0.5 mg/L NO_2^-
Sufficient for:	120 tests
Shelf life:	at least 1.5 years
Sea water suitability:	yes

***VISOCOLOR® HE* Nitrite**	**REF 920 063**
Refill pack	**REF 920 163**
Type:	highly sensitive test kit
Range:	0.0 · 0.005 · 0.010 · 0.015 · 0.02 · 0.03 · 0.04 · 0.06 · 0.08 · 0.10 mg/L NO_2^-
Sufficient for:	150 tests
Shelf life:	at least 2 years
Sea water suitability:	yes

Oxygen

O_2

The solubility of oxygen in water depends on the temperature, the pressure and other water components. The oxygen content of water at the time of sampling is often quoted as the percentage of possible saturation.

Reaction basis:
Oxygen determination according to Winkler: in alkaline solution dissolved oxygen oxidises manganese(II) ions to higher-valent manganese hydroxides. In a strongly acidic medium these form manganese(III) ions which can be determined either titrimetrically or colorimetrically after addition of a color reagent.

***VISOCOLOR® ECO* Oxygen**	**REF 931 088**
Refill pack	**REF 931 288**
Type:	colorimetric test kit
Range:	0 · 1 · 2 · 3 · 4 · 6 · 8 · 10 mg/L O_2
Sufficient for:	50 tests
Shelf life:	at least 1 year
Sea water suitability:	yes

When ordering this test kit for the first time, you also need an oxygen bottle, REF 915 498

***VISOCOLOR® HE* Oxygen SA 10**	**REF 915 009**
Refill pack	**REF 915 209**
Type:	titration test kit, according to DIN EN 25 813
Range:	0.2–10 mg/L O_2 1 gradation mark = 0.2 mg/L
Sufficient for:	about 100 tests with an average oxygen content of 9 mg/L
Shelf life:	at least 1.5 years
Sea water suitability:	yes

In combination with the BOD_5 accessories package (REF 916 918) and the BOD_5 nutrient mixture without N-allylthiourea (ATU) (REF 918 994) or the BOD_5 nutrient mixture Plus with ATU (REF 918 995) this test kit can also be used for determination of the BOD_5 (sufficient for 25–50 samples). Preparation of the samples is performed using the so-called dilution principle according to DIN ISO 1899-1-H51.

Test kits for water analysis

Description of individual parameters and tests

pH value

pH

The pH value indicates whether a water reacts acidic, alkaline or neutral. It is determined by the concentration of hydrogen ions. All biological processes in water are tied to specific pH ranges. For municipal and industrial applications, too, the control of specific pH limits is important since e.g. the efficiency of sewage plants or the corrosive potential of tap water on pipes depend in the pH value. Contrary to pH indicator papers, *VISOCOLOR*® pH test kits can also be used to determine accurate pH values in unbuffered sample solutions.

Reaction basis:
A special mixture of indicator dyes shows a characteristic color for every pH value within the range of the kit.

The favorable ratio between sample volume and amount of indicator minimizes the indicator error (acid-base-error). This allows reliable pH measurements in weakly buffered solutions as well. High contents of neutral salts and colloids as well as organic solvent concentrations above 10 % can cause wrong results.

VISOCOLOR® alpha pH 5–9 **REF 935 075**

Type:	colorimetric test kit
Range:	pH 5.0 · 5.5 · 6.0 · 6.5 · 7.0 · 7.5 · 8.0 · 8.5 · 9.0
Sufficient for:	200 tests
Shelf life:	at least 3 years
Sea water suitability:	yes

VISOCOLOR® ECO pH 4.0–9.0 **REF 931 066**
Refill pack **REF 931 266**

Type:	colorimetric test kit
Range:	pH 4.0 · 5.0 · 6.0 · 6.5 · 7.0 · 7.5 · 8.0 · 8.5 · 9.0
Sufficient for:	450 tests
Shelf life:	at least 3 years
Sea water suitability:	yes

VISOCOLOR® ECO pH 6.0–8.2 **REF 931 270**

Type:	reagent set for photometric determination
Range:	pH 6.0–8.2
Sufficient for:	150 tests
Shelf life:	at least 1.5 years
Sea water suitability:	yes

A visual colorimetric determination is not possible.

VISOCOLOR® HE pH 4.0–10.0 **REF 920 074**
Refill pack **REF 920 174**

Type:	highly sensitive test kit
Range:	pH 4.0 · 5.0 · 5.5 · 6.0 · 6.5 · 7.0 · 7.5 · 8.0 · 8.5 · 9.0 · 10.0
Sufficient for:	500 tests
Shelf life:	at least 2 years
Sea water suitability:	yes

For the determination of the pH value, see also Swimming pool page 69

Phosphate

PO_4^{3-}

The phosphate content in surface water has direct consequences for its ability to support the growth of certain organisms. Since increasing quantities of phosphates are being fed through domestic waste waters into rivers and lakes, these waters have a tendency towards eutrophication. Exact data about the phosphate content are important for boiler water and feed water. Precise dosing of phosphates in these waters can inhibit formation of boiler scale. Pyro-, meta- and polyphosphates are not determined with *VISOCOLOR*® test kits. The determination of total phosphate requires a decomposition prior to the test.

Reaction basis:
Ammonium molybdate reacts with phosphate ions to form phosphomolybdic acid which is reduced to molybdenum blue (Reaction basis according to DIN EN ISO 6878-D11).

VISOCOLOR® alpha Phosphate **REF 935 079**

Type:	colorimetric test kit
Range:	2 · 5 · 10 · 15 · 20 mg/L PO_4^{3-}
Sufficient for:	70 tests
Shelf life:	at least 2 years
Sea water suitability:	yes

VISOCOLOR® ECO Phosphate **REF 931 084**
Refill pack **REF 931 284**

Type:	colorimetric test kit
Range:	0 · 0.2 · 0.3 · 0.5 · 0.7 · 1 · 2 · 3 · 5 mg/L PO_4-P
Sufficient for:	90 tests
Shelf life:	at least 3 years
Sea water suitability:	yes

VISOCOLOR® HE Phosphate **REF 920 082**
Refill pack **REF 920 182**

Type:	highly sensitive test kit
Range:	0.0 · 0.05 · 0.10 · 0.15 · 0.20 · 0.3 · 0.4 · 0.6 · 0.8 · 1.0 mg/L P
Sufficient for:	300 tests
Shelf life:	at least 2 years
Sea water suitability:	yes

VISOCOLOR® HE Phosphate (DEV) **REF 920 080**
Refill pack **REF 920 180**

Type:	highly sensitive test kit
Range:	0.0 · 0.01 · 0.02 · 0.03 · 0.05 · 0.07 · 0.10 · 0.15 · 0.20 · 0.25 mg/L P
Sufficient for:	100 tests
Shelf life:	at least 2 years
Sea water suitability:	yes

Phosphonate

PO_x

Phosphonates are used as complexing agents for softening process and cooling water. They can be determined with *NANOCOLOR® NanOx* Metal and *VISOCOLOR® ECO* Phosphate. Please ask for our special instructions.

Potassium

K^+

The natural potassium content in ground water is generally about 1–2 mg/L K^+. Higher values may indicate faecal contaminations, but can also originate from potassium fertilizers. For the growth of plants and animals, potassium is an essential factor. Especially in agriculture the determination of potassium therefore gains increasing importance.

Reaction basis:
Potassium reacts with sodium tetraphenylborate to form a precipitate. Under defined conditions this turbidity can be used for concentration measurements.

Turbidities interfere and have to be filtered prior to the test. Good reproducibility is obtained for drinking, surface and ground water. For polluted waste waters low potassium values may be measured.

VISOCOLOR® ECO Potassium **REF 931 032**
Refill pack **REF 931 232**

Type:	turbidity test kit
Range:	2 · 3 · 4 · 6 · 8 · 10 · 15 mg/L K^+
Sufficient for:	60 tests
Shelf life:	at least 3 years
Sea water suitability:	yes, after dilution (1+1)

Residual hardness

°e

see hardness (total and residual), page 62

Silica / silicon

SiO_2

Natural water contains silica in different amounts, depending on the geological conditions. The silica occurs partly as soluble silicate, partly colloidal as polysilicic acids. The silica content in water for medium and high pressure boilers may not exceed certain limits. Therefore, in power plants constant measurement of the silica content is required.

Reaction basis:
In acidic solution soluble silica or silicates react with ammonium molybdate to form yellow silicomolybdic acid, which is reduced to silico-molybdenum blue with a reducing agent. (Reaction basis according to DIN EN ISO 16264-H57).

VISOCOLOR® ECO Silica **REF 931 033**
Refill pack **REF 931 233**

Type:	colorimetric test kit
Range:	0 · 0.2 · 0.4 · 0.6 · 1.0 · 1.5 · 2.0 · 2.5 · 3.0 mg/L SiO_2
Sufficient for:	80 tests
Shelf life:	at least 3 years
Sea water suitability:	yes

VISOCOLOR® HE Silicon **REF 920 087**
Refill pack **REF 920 187**

Type:	highly sensitive test kit
Range:	0.0 · 0.01 · 0.02 · 0.03 · 0.05 · 0.07 · 0.10 · 0.15 · 0.20 · 0.30 mg/L Si
Sufficient for:	120 tests
Shelf life:	at least 2 years
Sea water suitability:	yes

Sodium

Na^+

About 2.43 % of the uppermost crust of the earth, with a thickness of 16 km, consist of chemically bonded sodium. It is the 6th most abundant element on our planet. In rocks and minerals it is mostly present as silicate (e.g. soda feldspar or albite) and as sodium chloride (rocksalt), but also as carbonate, nitrate (especially chile salpeter) and cryolite as well as in many other minerals. Each ton of sea water contains an average of 27 kg common salt (10.6 kg sodium), so, sodium makes up for 77 % of all salts present in sea water. Under the assumption, that in natural waters beside sodium mainly calcium and magnesium can occur as cations, it is easily possible to determine the sodium content using *VISOCOLOR*® titration test kits. Please ask for the respective special instructions.

Sulfate

SO_4^{2-}

The determination of sulfate ions is of special importance to evaluate the aggressiveness of a water towards concrete. Sulfate, a component of natural water, is formed in many manufacturing processes and is found in waste waters even after neutralization.

Reaction basis:
Sulfate reacts with barium ions forming a precipitate of barium sulfate. Under defined conditions this turbidity can be used for concentration measurements.

Turbidities of the sample interfere and have to be filtered. Good reproducibility is obtained for drinking, surface and ground water. For polluted waste waters low concentrations are measured.

***VISOCOLOR*® *ECO* Sulfate**	**REF 931 092**
Refill pack	**REF 931 292**
Type:	turbidity test kit
Range:	25 · 30 · 35 · 40 · 50 · 60 · 70 · 80 · 100 · 120 · 150 · 200 mg/L SO_4^{2-}
Sufficient for:	100 tests
Shelf life:	at least 3 years
Sea water suitability:	yes, after dilution (1:50)

Sulfide

S^{2-}

In water sulfides can be present as dissolved hydrogen sulfide or as hydrosulfide or sulfide ions.

Reaction basis:
N,N-Dimethyl-1,4-phenylene diamine reacts with hydrogen sulfide to form an unstable compound which rearranges to leucomethylene blue. Oxidation with iron(III) ions yields methylene blue.

***VISOCOLOR*® *ECO* Sulfide**	**REF 931 094**
Refill pack	**REF 931 294**
Type:	colorimetric test kit
Range:	0.1 · 0.2 · 0.3 · 0.4 · 0.5 · 0.6 · 0.7 · 0.8 mg/L S^{2-}
Sufficient for:	90 tests
Shelf life:	at least 3 years
Sea water suitability:	yes

Sulfite

SO_3^{2-}

Sulfite ions are not present in natural, unpolluted waters, however they often appear in large quantities in industrial waste waters (e.g. paper mills, dye works).

Reaction basis:
Titrimetric determination by addition of iodine solution and reverse titration of unused iodine with sodium thiosulfate.

Oxidizing and reducing substances interfere.

***VISOCOLOR*® *ECO* Sulfite**	**REF 931 095**
Type:	titration test kit
Range:	1 drop = 1 mg/L SO_3^{2-}
Sufficient for:	60 tests with an average Sulfite concentration of 10 mg/L SO_3^{2-}
Shelf life:	at least 1 year
Sea water suitability:	yes

***VISOCOLOR*® *HE* Sulfite SU 100**	**REF 915 008**
Refill pack	**REF 915 208**
Type:	titration test kit
Range:	2–100 mg/L SO_3^{2-} 1 gradation mark = 2 mg/L
Sufficient for:	100 tests with an average Sulfite content of 100 mg/L SO_3^{2-}
Shelf life:	at least 3 years
Sea water suitability:	yes

Swimming pool

Cl_2 pH

Chlorination of water in swimming pools with chlorine or chlorine compounds takes place within certain limits. One distinguishes between free chlorine and bound chlorine (chloroamines); the sum of both is called total chlorine. The content of free chlorine should be between 0.3 and 0.6 mg/L. Chlorination alters the pH value of the swimming pool water. The ideal pH value is pH 7.4. This prevents formation of malodorous pollutants and irritants to the mucous membrane, and prevents damage to the water treatment system.

Reaction basis:
Free chlorine reacts with *N,N*-diethyl-1,4-phenylene diamine (DPD) to form a red-violet dye. The pH value is determined with phenol red as indicator.

For test kits for the determination of chlorine alone see *VISOCOLOR*® Chlorine (see page 59)

***VISOCOLOR*® *ECO* Swimming pool**	**REF 931 090**
Refill pack	**REF 931 290**
Type:	colorimetric test kit
Range:	< 0.1 · 0.2 · 0.3 · 0.4 · 0,6 · 0.9 · 1.2 · 2.0 mg/L Cl_2 pH 6.9 · 7.2 · 7.4 · 7.6 · 7.8 · 8.2
Sufficient for:	150 tests each
Shelf life:	at least 1.5 years
Sea water suitability:	yes

Zinc

Zn^{2+}

Zinc is one of the most often used metals for surface finishing. Its content in waste water from e.g. electroplating companies has to be monitored regularly.

Reaction basis:
At a pH of 8.5–9.5 zinc ions react with zincon to form a color complex. Acidic, alkaline and buffered samples have to be adjusted to pH 9 for the test.

***VISOCOLOR*® *ECO* Zinc**	**REF 931 098**
Refill pack	**REF 931 298**
Type:	colorimetric test kit
Range:	0 · 0.5 · 1 · 2 · 3 mg/L Zn^{2+}
Sufficient for:	120 tests
Shelf life:	at least 1 year
Sea water suitability:	yes, after dilution (1+9)

Reagent cases

Combinations of different *VISOCOLOR*® test kits

Reagent cases for all purposes

- **Rugged cases with premium foam inlays**
- **Pre-packed or empty cases for individual solutions**
- **With and without photometer PF-12**

MACHEREY-NAGEL reagent cases are flexible tools for all areas of water and soil analysis. The cases are ideal for testing water bodies, for fish farming and a wide variety of other applications within the area of environmental management and water monitoring.

The reagent cases enable users to get results fast and directly at the point of interest. Previous chemical knowledge or experience is not required to run any of the tests or to use the cases effectively.

The cases include all necessary test instructions and analytical accessories for especially easy and convenient handling.

Ordering information

Type	For the determination of	REF
Reagent case for soil analysis		
VISOCOLOR® reagent case for soil analysis*	Phosphate, potassium, nitrogen (ammonium, nitrite and nitrate), pH, soil structure, incl. all requisite equipment and accessories	**931 601**
Reagent case for schools		
VISOCOLOR® *SCHOOL* *	Ammonium, nitrate, nitrite, phosphate, pH, total hardness	**933 100**
Reagent case for water analysis · without photometer		
VISOCOLOR® *ECO* reagent case*	Ammonium, carbonate hardness, total hardness, nitrate, nitrite, pH, phosphate	**931 301**
VISOCOLOR® *ECO* reagent case, empty	For individual combination of up to 8 test kits of type *VISOCOLOR*® *ECO*	**931 303**
VISOCOLOR® reagent case*	Alkalinity, ammonium, total hardness, nitrite, pH, phosphate, oxygen, temperature	**931 304**
VISOCOLOR® reagent case, empty	For combination with products from the Rapid Tests and the *VISOCOLOR*® lines	**931 305**
Reagent case for water analysis · with photometer PF-12		
Reagent case "Environmental analysis"*	Ammonium, carbonate hardness, iron, total hardness, nitrate, nitrite, pH, phosphate, incl. photometer PF-12	**914 303**
VISOCOLOR® reagent case with PF-12	For combination with products from the Rapid Tests and the *VISOCOLOR*® lines	**914 301**

* This product contains harmful substances which must be specially labeled as hazardous. For detailed information please see MSDS.

Soil analysis made easy

New design!

- **Easy sample preparation**
- **Fast evaluation of nutrients in soil**
- **Convenient and reliable determination even in the field**

VISOCOLOR® reagent case for soil analysis REF 931 601

Thorough analysis is a corner stone to support and maintain healthy, productive and biologically active soil. To effectively and efficiently plan all measures that affect the soil (fertilization, liming, etc.) it is crucial to determine the important soil parameters first. The *VISOCOLOR*® reagent case for soil analysis is the perfect companion for economical, fast and convenient soil analysis, both in the field or in your laboratory, including the following tests:

QUANTOFIX® test strips:

• Ammonium	10–400 mg/L NH_4^+
• Nitrate / Nitrite	10–500 mg/L NO_3^- / 1–80 mg/L NO_2^-

***VISOCOLOR*® *ECO* test kits:**

• Potassium	2–15 mg/L K^+

***VISOCOLOR*® *HE* test kits:**

• Phosphate	1–20 mg P/100 g
• pH	4.0–10.0

pH-Fix test strip

• pH	2.0–9.0

Depending on the parameter to be determined, the soil extracts are prepared with Calcium-Acetate-Lactate (CAL) or with $CaCl_2$ solution. If required by national regulations or because of local geological conditions, the *VISOCOLOR*® reagent case for soil analysis can also be used with other extraction solutions.

Soil analysis in no time

- Manual with background information
- Ideal combination of test papers and colorimetric test kits
- Incl. additional analytical tools, such as scale, sieve etc.

In addition to the reagent case, various *VISOCOLOR*® reagents can also be used for soil analysis. Please request information about suitable extraction solutions.

Combinations of different *VISOCOLOR*® test kits

Water analysis – it's that simple

- **Easy test procedures**
- **Safe results**
- **Flexible applications**
- **Incredible value**

VISOCOLOR® *SCHOOL* reagent case REF 933 100

The *VISOCOLOR*® *SCHOOL* reagent case is especially designed for schools and caters to the needs of both students and teachers. All reagents are approved to be used in schools in Germany (GUV-SR 2004 directive) and can be disposed of easily just down the drain without any harm to the environment.

***VISOCOLOR*® *SCHOOL* reagents:**

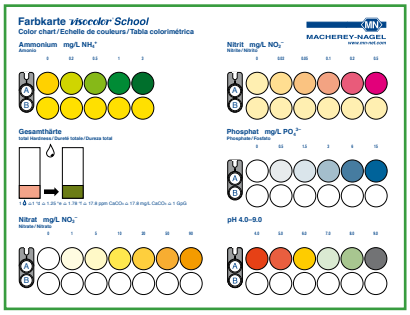
Ammonium	0.2–3 mg/L NH_4^+
Nitrate	1–90 mg/L NO_3^-
Nitrite	0.02–0.5 mg/L NO_2^-
Phosphate	0.5–15 mg/L PO_4^{3-}
pH	4.0–9.0
Total hardness	1 drop ≙ 17.8 mg/L $CaCO_3$

The newly developed tests are based on our proven *VISOCOLOR*® system and were developed as high quality *VISOCOLOR*® *SCHOOL* test specifically for schools.

Great features – incredible price

- Maximum safety due to exact labeling of all reagents
- Safe results using color and turbidity compensation
- High sensitivity down to the values of German drinking water standards
- Safe for the environment and easy disposal of used tests

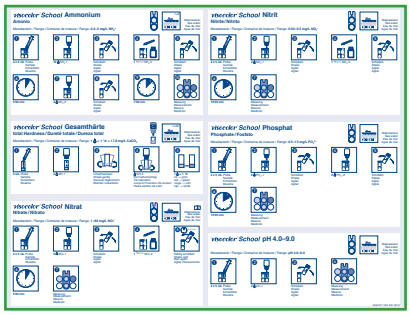
High accuracy



- Color matching with all-in-one color scale
- Compensation of turbidity and colors
- Reaction principles based on international standards

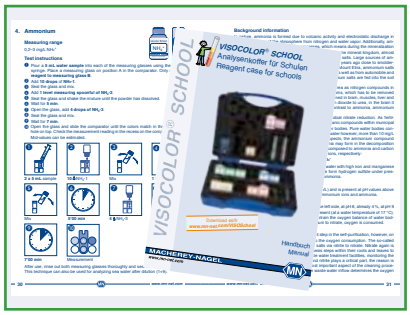
NEW!

Simple and safe



- Easy test procedures with pictogram instructions
- Color-coded reagent bottles
- No additional accessories required

Extensive manual



- Background information about the parameters
- Declaration of the reaction basis as well as reaction equation
- Data about interferences

Optionally, the case can be equipped with a pack of pH-Fix or QUANTOFIX® test strips as well.

Ordering information

Type	REF
VISOCOLOR® *SCHOOL* refill pack*	**933 200**
VISOCOLOR® *SCHOOL* color chart	**933 300**
VISOCOLOR® *SCHOOL* manual (German / English)	**933 150**

* This product contains harmful substances which must be specially labeled as hazardous. For detailed information please see MSDS.

Reagent cases

Combinations of different *VISOCOLOR*® test kits

Reagent cases for water analysis without photometer

- **Easy to handle mini-lab**
- **For exact and accurate determination**
- **Expandable with one additional *VISOCOLOR*® *ECO* test**
- **Compact case for extensive analysis**
- **Highly sensitive *VISOCOLOR*® *HE* tests included**
- **Infinite options**

VISOCOLOR® *ECO* reagent case — REF 931 301

For mobile use with test instructions for visual determination, analytical accessories and the following tests:

***VISOCOLOR*® *ECO* test kits:**

Ammonium	0.2–3 mg/L NH_4^+
Carbonate Hardness	1 drop ≙ 1.25 °e
total Hardness	1 drop ≙ 1.25 °e
Nitrate	1–120 mg/L NO_3^-
Nitrite	0.02–0.5 mg/L NO_2^-
pH	pH 4.0–9.0
Phosphate	0.2–5 mg/L P

VISOCOLOR® reagent case — REF 931 304

For mobile use with test instructions for colorimetric and titrimetric determinations with *VISOCOLOR*® tests, analytical accessories as well as the following test kits:

***VISOCOLOR*® *ECO* test kits:**

Ammonium 3	0.2–3 mg/L NH_4^+
Nitrite	0.02–0.5 mg/L NO_2^-
Phosphate	0.2–5 mg/L P
pH 4.0–9.0	pH 4.0–9.0

***VISOCOLOR*® *HE* test kits:**

Alkalinity AL 7	0.2–7.0 mmol/L
total Hardness H 20 F	0.6–25.0 °e
Oxygen SA 10	0.2–10.0 mg/L O_2

VISOCOLOR® *ECO* reagent case, empty — REF 931 303

The empty *VISOCOLOR*® *ECO* reagent case allows the case to be equipped in an individual and highly flexible way with 8 different *VISOCOLOR*® *ECO* test kits.

In addition to the colorimetric and titrimetric *VISOCOLOR*® *ECO* tests the reagent case can be equipped with *VISOCOLOR*® *ECO* turbidity tests for potassium, cyanuric acid and sulphate as well. Furthermore the cases can be equipped with the *VISOCOLOR*® *ECO* Oxygen test including the necessary oxygen flask.

VISOCOLOR® reagent case, empty — REF 931 305

The empty *VISOCOLOR*® reagent case enable you to freely combine every combination of *VISOCOLOR*® tests, pH indicator papers, pH-Fix test strips, qualitative test papers and semi-quantitative QUANTOFIX® test strips.

Additionally, the case can be equipped with *VISOCOLOR*® *ECO* turbidity tests for potassium, cyanuric acid and sulfate as well as with the *VISOCOLOR*® *ECO* or *VISOCOLOR*® *HE* Oxygen test including oxygen flask.

Combinations of different *VISOCOLOR*® test kits

Reagent cases with photometer PF-12

- **The all-rounder for any purposes**
- **Increased accuracy and reproducibility**
- **Infinite options**

VISOCOLOR® reagent case "Environmental analysis" REF 914 303

Reagent case with photometer PF-12 (see page 74) incl. instrument manual, *VISOCOLOR*® *ECO* test instructions as well as test instructions for titration test kits, analytical accessories and the following test kits:

***VISOCOLOR*® *ECO* test kits:**

Ammonium 15	0.5–15 mg/L NH_4^+
Iron	0.04–1.0 mg/L Fe
Nitrate	1–120 mg/L NO_3^-
Nitrite	0.02–0.5 mg/L NO_2^-
Phosphate	0.2–5 mg/L P
pH 4.0–9.0	pH 4.0–9.0

***VISOCOLOR*® *HE* test kits:**

Carbonate hardness C 20	0.6–25.0 °e
total Hardness H 20 F	0.6–25.0 °e

VISOCOLOR® reagent case with PF-12, without test kits REF 914 301

The premium foam inlays of the empty *VISOCOLOR*® reagent case with PF-12 allow the case to be equipped in an individual and highly flexible way with every combination of the *VISOCOLOR*® tests as well as pH indicator papers, pH-Fix test strips, qualitative test papers and semi-quantitative QUANTOFIX® test strips.

Customized case solutions

Catering to individual customer needs is of the great importance to MACHEREY-NAGEL. Even though our case solutions already provide a high level of flexibility, we recognize that some customers may have specific requirements outside our existing case solutions. Therefore, we offer entirely individual solutions with a foam inlay designed exactly to your specifications and testing needs. Staring at a minimum of 50 cases, we can provide you with a case that perfectly fits your personal requirements. In addition to a special inlay, we also offer readily packed cases starting at a minimum quantity of 50 cases as well.

Thus, within our highly flexible case range, we can provide virtually any customer with the perfect testing and transportation solution.

For a case solution for test strip and test papers without *VISOCOLOR*® test kits, see page 46.

Photometer for water analysis

Compact photometer PF-12

Maximum flexibility

- **More than 100 preprogrammed methods**
- **Automatic wavelength adjustment**
- **Backlit graphic display with intuitive userguidance**
- **Data storage according to GLP**
- **USB interface for data transfer, update and power supply**

Experience flexibility

The compact photometer PF-12 is the logical result of a further development based on our very successful photometer PF-11. Adapted to our customers' requirements the PF-12 impresses with modern design and precise analytics. Preprogrammed tests, automatic wavelength adjustment and the intuitive userguidance allow fast and easy operation. Results are stored according to GLP and transferred safely to your PC with the included PC-software. The PF-12 features an unrivaled flexibility with variable power supply via mains supply, standard and rechargeable batteries, PC and 12 V car adapter. Additionally, the PF-12 offers photometric analysis of *VISOCOLOR*® *ECO* tests and *NANOCOLOR*® tube tests including all relevant parameters for water and waste water analysis and individual combination of tests in the new reagent cases.

Save time

Backlit graphic display with self-explanatory userguidance

- All tests and menu items can be activated fast and easily
- Operation without complex and time-consuming training

Results within seconds

The progressively designed optics is insensitive to external light and makes measuring straightforward

Be prepared for the future

Fast photometer update–free of charge

- At any time, stay up-to-date with our easy online software update
- For current software updates please visit ***www.mn-net.com***

Assure results

Documentation of results according to GLP

- Individual entries of sample number, sample location and dilution

Clear memory management

- GLP-conform storage of results with all supplementary information such as date, time, sample number, sample location and dilution
- Fast and easy access to stored results and data sets

Convenient data export

- *NANOCOLOR*® Software DVD included in delivery
- Easy transfer of results to PC
- Data export directly to MS Excel
- Recording of calibration curves to program user-defined methods

Internal quality control according to ISO 9001

- Fulfill supervisor and authority requirements
- Fast and easy self-monitoring of photometric accuracy with *NANOCONTROL* NANOCHECK (REF 925 701)

Photometer for water analysis

Compact photometer PF-12

Be mobile

Works under any condition

• Variable power supply for mobile use:

Standard and rechargeable batteries for more than 2000 off the line measurements

USB adaptor (REF 919 220) for cigarette lighter in the car

USB adaptor for mains supply in the lab

• Power saving auto-off function after 5, 10, 15 or 20 min

• Waterproof housing (IP 67)

Enjoy versatility

Complete water and waste water analysis

• Ammonium, Chlorine, total N, total P, Nitrate, Nitrite, all COD tests and many more

• More than 100 preprogrammed tests
  · *VISOCOLOR*® *ECO* tests
  · *NANOCOLOR*® tube tests

• Programmable for 10 user-defined methods

• Photometric basic functions: absorbance, transmission, factor and standard

Endless opportunities

Individual mini-labs

• Portable reagent cases with photometer PF-12

• Photometric analysis of *VISOCOLOR*® *ECO* tests can be combined with:

Qualitative test papers, *VISOCOLOR*® reagent bottles,

QUANTOFIX® test strips, pH-Fix test strips, pH indicator papers

and accessories

Please find further information and examples of reagent cases with photometer PF-12 on page 73.

Photometer for water analysis

Compact photometer PF-12

Technical data

Type:	Filter photometer with microprocessor control, self-test and auto-calibration Wavelength range 340–860 nm
Optics:	Automatic filter wheel with 7 interference filters Insensitive to external light–no light shield required
Wavelengths:	345 / 436 / 470 / 540 / 585 / 620 / 690 nm plus 1 compartment for an additional filter
Wavelength accuracy:	± 2 nm, bandwidth at half transmission 10–12 nm
Light source:	Tungsten lamp
Detector:	Silicon photodiode
Blank value:	Automatic
Measuring modes:	Over 100 preprogrammed tests (*NANOCOLOR*® tube tests and *VISOCOLOR*® *ECO* tests) Absorbance, transmission, factor, standard 10 freely programmable methods
Photometric range:	± 3 E
Photometric accuracy:	± 1 %
Stability:	< 0.002 E/h
Cuvette holder:	Round tubes 16 mm OD
Data memory:	200 results, GLP conform
Display:	Backlit graphic display, 64 x 128 pixels All important data at a glance: Result in respective unit, date, time, sample number, sample location and dilution
Operation:	Display userguidance, plastic foil keyboard Test selection via test number or parameter lists 12 languages (de, en, fr, es, it, nl, hu, pl, pt, cz, id, si)
Quality Control:	With *NANOCONTROL* NANOCHECK
Interface:	USB 2.0
Update:	Via Internet / PC, free of charge
Operating range:	0–50 °C, up to 90 % relative humidity
Power supply:	Via USB power supply, standard or rechargeable batteries
Housing:	Waterproof, IP 67
Dimensions:	215 x 100 x 65 mm
Weight:	0.7 kg
Warranty:	2 years
CE This device complies with the following directives: - 2006/95/EG - Low-Voltage Directive - 2004/108/EG - EMC-Directive	

Ordering information

Description	REF
Compact photometer PF-12 Incl. software DVD, manual, 4 batteries, 4 empty test tubes, funnel, beaker, syringe, USB cable, calibration cuvette and certificate in rugged case	**919 200**
Accu pack	**919 201**
USB power supply	**919 220**
Charger	**919 221**

VISOCOLOR® ECO and *NANOCOLOR®* tests which can be evaluated with the PF-12

Ordering information

Test	Ranges	Test no	Wavelength	No of tests	REF
VISOCOLOR® ECO					
Ammonium 3*	0.1–2.5 mg/L NH_4^+	5-08	690	50	**931 208**
Ammonium 15*	0.5–8.0 mg/L NH_4^+	5-10	585	50	**931 210**
Chloride*	1–60 mg/L Cl^-	5-18	470	90	**931 218**
Chlorine 2, free + total	0.10–2.00 mg/L Cl_2	5-15	540	150	**931 215**
free Chlorine 2	0.10–2.00 mg/L Cl_2	5-16	540	150	**931 216**
Chlorine 6, free + total	0.05–6.00 mg/L Cl_2	5-17	540	200	**931 217**
free Chlorine 6	0.05–6.00 mg/L Cl_2	5-19	540	400	**931 219**
Chlorine dioxide*	0.20–3.80 mg/L ClO_2	5-21	540	150	**931 221**
Chromium(VI)*	0.04–1.00 mg/L CrO_4^{2-}	5-20	540	140	**931 220**
Copper	0.1–5.0 mg/L Cu^{2+}	5-37	585	100	**931 237**
Cyanide*	0.01–0.20 mg/L CN^-	5-22	585	100	**931 222**
Cyanuric acid*	10–100 mg/L Cya	5-23	540	100	**931 223**
Fluoride	0.1–2.0 mg/L F^-	5-27	585	150	**931 227**
Hydrazine*	0.05–0.40 mg/L N_2H_4	5-30	436	130	**931 230**
Iron 1*	0.10–2.00 mg/L Fe	5-25	540	200	**931 225**
Iron 2	0.04–2.00 mg/L Fe	5-26	540	100	**931 226**
Manganese*	0.1–5.0 mg/L Mn^{2+}	5-38	436	70	**931 238**
Nickel*	0.1–5.0 mg/L Ni^{2+}	5-40	470	150	**931 240**
Nitrate*	1–80 mg/L NO_3^-	5-41	436	110	**931 241**
Nitrite	0.02–0.50 mg/L NO_2^-	5-44	540	120	**931 244**
Oxygen*	1–8 mg/L O_2	5-88	540	50	**931 288**
pH 6.0–8.2	pH 6.0–8.2	5-70	436/540	150	**931 270**
Phosphate*	0.2–5.0 mg/L PO_4-P 0.6–15 mg/L PO_4^{3-}	5-84	690	80	**931 284**
Potassium*	2–25 mg/L K^+	5-32	690	60	**931 232**
Silica	0.2–3.0 mg/L SiO_2	5-33	690	80	**931 233**
Sulfate*	20–200 mg/L SO_4^{2-}	5-92	436	100	**931 292**
Sulfide*	0.05–0.80 mg/L S_2^-	5-94	620	90	**931 294**
Zinc	0.1–3.0 mg/L Zn^{2+}	5-98	620	120	**931 298**
***NANOCOLOR®* tube tests**					
Aluminum 07	0.02–0.70 mg/L Al^{3+}	0-98	540	19	**985 098**
Ammonium 3	0.04–2.30 mg/L NH_4-N 0.05–3.00 mg/L NH_4^+	0-03	690	20	**985 003**
Ammonium 10	0.2–8.0 mg/L NH_4-N 0.2–10 mg/L NH_4^+	0-04	690	20	**985 004**
Ammonium 50	1–40 mg/L NH_4-N 1–50 mg/L NH_4^+	0-05	690	20	**985 005**
Ammonium 100	4–80 mg/L NH_4-N 5–100 mg/L NH_4^+	0-08	585	20	**985 008**
Ammonium 200	30–160 mg/L NH_4-N 40–200 mg/L NH_4^+	0-06	585	20	**985 006**
AOX 3*	0.1–3.0 mg/L AOX 0.01–0.30 mg/L AOX	0-07	470	20	**985 007**
BOD_5*	0.5–12.0 mg/L O_2	8-22	470	25-50	**985 822**
BOD_5-TT*	0.5–7.5 mg/L O_2	8-25	436	11-21	**985 825**
Cadmium 2	0.05–2.00 mg/L Cd^{2+}	0-14	540	10-19	**985 014**
Carbonate hardness 15	1.0–18.0 °e 0.4–5.4 mmol/L H^+	0-15	436/585	20	**985 015**
Chloride 50*	0.5–50.0 mg/L Cl^-	0-21	470	20	**985 021**
Chloride 200*	5–200 mg/L Cl^-	0-19	470	20	**985 019**

* This product contains harmful substances which must be specially labeled as hazardous. For detailed information please see MSDS.

Photometer for water analysis

Compact photometer PF-12

Test	Ranges	Test no	Wavelength	No of tests	REF
Chlorine/Ozone 2*	0.05–2.50 mg/L Cl_2 0.05–2.00 mg/L O_3	0-17	540	20	**985 017**
Chlorine dioxide 5	0.15–5.00 mg/L ClO_2	0-18	540	20	**985 018**
Chromate 5	0.05–2.00 mg/L Cr(VI) 0.1–4.0 mg/L CrO_4^{2-}	0-24	540	20	**985 024**
COD 40*	2–40 mg/L O_2	0-27	345	20	**985 027**
COD 60*	5–60 mg/L O_2	0-22	345	20	**985 022**
COD 160*	15–160 mg/L O_2	0-26	436	20	**985 026**
COD 160 Hg-free*	15–160 mg/L O_2	0-26	436	20	**963 026**
COD 300*	50–300 mg/L O_2	0-33	436	20	**985 033**
COD 600*	50–600 mg/L O_2	0-30	620	20	**985 030**
COD 1500*	100–1500 mg/L O_2	0-29	620	20	**985 029**
COD 4000*	400–4000 mg/L O_2	0-11	620	20	**985 011**
COD 10000*	1.00–10.00 g/L O_2	0-23	620	20	**985 023**
COD 15000*	1.0–15.0 g/L O_2	0-28	620	20	**985 028**
COD 60000*	5.0–60.0 g/L O_2	0-12	620	20	**985 012**
org. Complexing agents 10 (Screeningtest)	0.5–10.0 mg/L IBiC	0-52	540	10–19	**985 052**
Copper 7	0.10–7.00 mg/L Cu^{2+}	0-54	585	20	**985 054**
Cyanide 08*	0.02–0.80 mg/L CN^-	0-31	585	20	**985 031**
DEHA 1 (Diethylhydroxylamine)	0.05–1.00 mg/L DEHA	0-35	540	20	**985 035**
Ethanol 1000	0.10–1.00 g/L EtOH	8-38	620	23	**985 838**
Fluoride 2	0.1–2.0 mg/L F^-	0-40	620	20	**985 040**
Formaldehyde 8*	0.1–8.0 mg/L HCHO	0-41	585	20	**985 041**
Formaldehyde 10	0.20–10.00 mg/L HCHO	0-46	436	10–19	**985 046**
Hardness 20	1.25–25.0 °e 5–50 mg/L Mg^{2+} 0.2–3.6 mmol/L 10–100 mg/L Ca^{2+}	0-43	540	20	**985 043**
HC 300* (hydrocarbons)	0.5–5.6 mg/L HC 30–300 mg/kg HC	0-57	436	20	**985 057**
Iron 3*	0.10–3.00 mg/L Fe	0-37	540	20	**985 037**
Lead 5*	0.10–5.00 mg/L Pb^{2+}	0-09	540	20	**985 009**
Manganese 10*	0.1–10.0 mg/L Mn^{2+}	0-58	470	20	**985 058**
Methanol 15	0.2–15.0 mg/L MeOH	8-59	620	23	**985 859**
Molybdenum 40*	1.0–30.0 mg/L Mo (VI) 1.6–50.0 mg/L MoO_4	0-56	345	20	**985 056**
Nickel 7*	0.10–7.00 mg/L Ni^{2+}	0-61	470	20	**985 061**
Nitrate 8*	0.30–8.00 mg/L NO_3-N 1.3–35.0 mg/L NO_3^-	0-65	345	20	**985 065**
Nitrate 50*	0.3–22.0 mg/L NO_3-N 2–100 mg/L NO_3^-	0-64	345	20	**985 064**
Nitrate 250*	4–60 mg/L NO_3-N 20–250 mg/L NO_3^-	0-66	345	20	**985 066**
Nitrite 2	0.003–0.460 mg/L NO_2-N 0.02–1.50 mg/L NO_2^-	0-68	540	20	**985 068**
Nitrite 4	0.1–4.0 mg/L NO_2-N 0.3–13.0 mg/L NO_2^-	0-69	540	20	**985 069**
total Nitrogen TN_b 22*	0.5–22.0 mg/L N	0-83	345	20	**985 083**
total Nitrogen TN_b 60*	3–60 mg/L N	0-92	345	20	**985 092**
total Nitrogen TN_b 220*	5–220 mg/L N	0-88	345	20	**985 088**
Organic acids 3000*	30–3000 mg/L CH_3COOH 0.5–50.0 mmol/L CH_3COOH	0-50	470	20	**985 050**
Oxygen 12*	0.5–12.0 mg/L O_2	0-82	436	22	**985 082**
Peroxide 2	0.03–2.00 mg/L H_2O_2	8-71	620	10–19	**985 871**

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Test	Ranges	Test no	Wavelength	No of tests	REF
pH 6.5-8.2	pH 6.5–8.2	0-72	436/540	100	**918 72**
Phenolic index 5	0.2–5.0 mg/L Phenol	0-74	470	10–19	**985 074**
Potassium 50*	2–50 mg/L K^+	0-45	690	20	**985 045**
ortho and total Phosphate 1	0.05–1.50 mg/L P 0.2–5.0 mg/L PO_4^{3-}	0-76	690	19	**985 076**
ortho and total Phosphate 5*	0.20–5.00 mg/L P 0.5–15.0 mg/L PO_4^{3-}	0-81	690	19	**985 081**
ortho and total Phosphate 15*	0.30–15.00 mg/L P 1.0–45.0 mg/L PO_4^{3-}	0-80	690	19	**985 080**
ortho and total Phosphate 45*	5.0–50.0 mg/L P 15–150 mg/L PO_4^{3-}	0-55	690	19	**985 055**
ortho and total Phosphate 50*	10.0–50.0 mg/L P 30–150 mg/L PO_4^{3-}	0-79	436	19	**985 079**
POC 200 (polyoxylcarboxylic acids)	20–200 mg/L	0-70	436	20	**985 070**
residual Hardness 1	0.03–1.25 °e 0.004–0.180 mmol/L	0-84	540	20	**985 084**
Silver 3	0.20–3.00 mg/L Ag^+	0-49	620	20	**985 049**
Starch 100	5–100 mg/L starch	0-85	540	19	**985 085**
Sulfate 200*	10–200 mg/L SO_4^{2-}	0-86	436	20	**985 086**
Sulfate 1000*	200–1000 mg/L SO_4^{2-}	0-87	436	20	**985 087**
Sulfide 3*	0.05–3.00 mg/L S^{2-}	0-73	620	20	**985 073**
Sulfite 10*	0.2–10.0 mg/L SO_3^{2-}	0-89	436	20	**985 089**
Sulfite 100*	5–100 mg/L SO_3^{2-}	0-90	470	19	**985 090**
Surfactants: Anionic surfactants 4*	0.20–4.00 mg/L MBAS	0-32	620	20	**985 032**
Surfactants: Cationic surfactants 4*	0.20–4.00 mg/L CTAB	0-34	620	20	**985 034**
Surfactants: Nonionic surfactants 15*	0.3–15.0 mg/L Triton® X-100	0-47	620	20	**985 047**
Thiocyanate 50*	0.5–50.0 mg/L SCN^-	0-91	470	20	**985 091**
TOC 25*	2.0–25.0 mg/L TOC	0-93	585	10	**985 093**
TOC 60	10–60 mg/L TOC	0-94	585	10	**985 094**
TOC 600*	40–600 mg/L TOC	0-99	585	10	**985 099**
TTC/Sludge activity 150*	5–150 µg TPF 0.050–2.300 E	8-90	470	20	**985 890**
Zinc 4*	0.10–4.00 mg/L Zn^{2+}	0-96	620	20	**985 096**

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