NANOCOLOR® 500 D

Bedienungsanleitung
Manual

NANOCOLOR® 500 D

Analysen von Trink-, Oberflächen-, Grund-, Brauch- und Abwasser

Analyses of drinking, surface, ground, process and waste water

CE

www.mn-net.com

MACHEREY-NAGEL

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1. Photometer *NANOCOLOR*® 500 D

The *NANOCOLOR*® 500 D is not only a high-performance photometer, it also features versatile software capabilities. With its large reserves of light at all wavelengths, the user can perform precise measurements, even at high extinctions.

Storage of all *NANOCOLOR*® analytical methods and multilingual user guidance facilitate measurement. Additional programmes such as measurement of extinction, kinetics, data networks, etc. expand the applicability beyond the *NANOCOLOR*® analytical system as an instrument which can be used in all types of application in the laboratory.

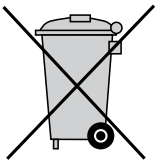
Additional features are: processing of non-linear curves, storage of measurement results, warning for values outside the measuring range, sample identification, possibility of programming the user's own analytical procedures, clear readings and user guidance via graphic display, etc.

1.1 Technical data

Technical data
Single beam filter photometer for a wavelength range from 340 to 860 nm
Silicon photo-element
Automatic zero adjustment
Graphic display 128 x 64 pixels
Foil-covered keys with tactile feedback
Cuvettes: rectangular cuvettes 10, 20 and 50 mm
round glass tubes 16 mm OD
Photometric accuracy: ± 1 %
Long-term stability: < 0.002 E/h
Power requirements: 9 V, max. 1 A
Power consumption: max. 9 VA at maximum charging current
Data interfaces: bidirectional RS 232 C interface
Universal Serial Bus USB 1.1
Dimensions: 227 x 282 x 105 mm
Weight: 2.4 kg

CE This appliance complies with the following EC Directives:
– 73/23/EEC of 02.19.1973 – Low Voltage Directive
– 89/336/EEC of 05.03.1989 (including Amendment Directive 92/31/EEC) – EMV Directive

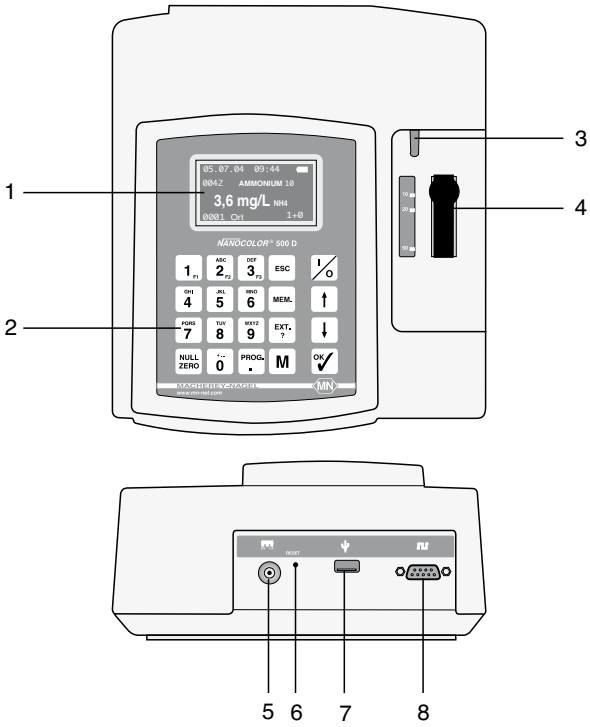
Disposal in accordance with EU directive 2002/96/EC



In compliance with EU directive 2002/96/EC, MACHEREY-NAGEL will accept back and dispose of the old instrument at no cost.

ATTENTION!
It is not allowed to dispose of the instrument using municipal waste disposal services. Please talk to your local MACHEREY-NAGEL contact.

1.2 Design of the photometer



1 graphic display 128 x 64 pixels
2 20-part keyboard
3 barcode scanner
4 cuvette slot with automatic cuvette identification
5 socket for connection of mains adaptor
6 RESET push button (subsurface)
7 USB (1.1) interface for data transfer and update
8 RS 232 C interface for suitable printers and data transfer

1.3 Filters

When the photometer *NANOCOLOR*® 500 D is switched on, it automatically performs a filter test. If a deviation is found, the program asks for a new calibration. Filters which have left the confidence interval, are displayed as <check filter>. In order to prevent wrong measurements, further evaluation of tests which require the defective filter is blocked.

Filter position	Wavelength of the light[a] [nm]	HW[b] of the filter [nm]	Color of the light / filter	Color impression (reaction color)
1	345[c]	60	ultraviolet	not visible
2	365	11	deep violet	not visible
3	436	12	violet	yellow
4	470	10	blue	orange
5	520	11	blue-green	magenta
6	540	11	green	red-violet
7	585	10	orange	blue-violet
8	620	10	red	blue
9	690	10	deep red	deep blue
10	800	10	infrared	black

[a] Interference filters: ± 2 nm, [b] HW = band width at half transmission,
[c] colored glass filter
Other interference filters on request.

1.4 Power supply and light source

Rechargeable battery
The built-in rechargeable battery allows stationary and mobile operation of the photometer *NANOCOLOR*® 500 D. Up to 3000 measurements are possible without recharging.

Charger / mains adaptor
If the display asks for <charging battery>, the photometer has to be connected to the mains using the charger / mains adaptor which is supplied with the instrument. During charging, the photometer can be operated. Permanent operation with the mains adaptor is possible, overcharging of the battery cannot occur.

Light source
An argon point lamp supplies the light for the measurement (340–860 nm). For every measurement the lamp emits just a short light pulse. This results in a very low energy consumption, a long service life of the lamp, and a large number of measurements per battery charge.

Replacement of lamp
For lamp replacement just remove the round lamp cover at the bottom of the instrument. Now the preadjusted lamp can be easily replaced.

1.5 Interface description

Universal – Serial-Bus USB 1.1
interface for computer connection with MACHEREY-NAGEL software for program update or data transfer Please note: install driver software for USB

RS 232 serial interface COM 9-pin SUB-D plug	
Pin 1	–
Pin 2	RXD Receive Data
Pin 3	TXD Transmit Data
Pin 4	–
Pin 5	COM Signal Ground
Pin 6	–
Pin 7	–
Pin 8	–
Pin 9	–
Basic settings: 19200 Baud, no parity, 8 data bits, 1 stop bit (19200-N81-SDF* (,)) Baud rates 19200 (9600 printer) *SDF semicolon delimited format or optional ASCII format	
interface for computer connection with MACHEREY-NAGEL software for program update or data transfer connection of a serial printer	

1.6 Barcode

The characteristic data for all *NANOCOLOR*® tests are stored in the photometer *NANOCOLOR*® 500 D. Selection of a method via method number is always possible. With the photometer *NANOCOLOR*® 500 D, the barcode on the test tubes performs this feature, thus simplifying the measurement and minimising possible errors during operation. The barcode activates the automatic measurement sequence up to the display of results. The barcode scanner is activated by insertion of the test tube.

The automatic measurement sequence can be interrupted immediately after insertion of the test tube using the arrow keys, thus allowing selection of another submethod. Always insert test tubes with barcode thus into the photometer that the scanner beam hits the barcode.

WARNING: *the barcode scanner is a Laser class 1 product. Do not look straight into the scanner during reading.*

1.7 Update via INTERNET

For updating the internal program of the *NANOCOLOR*® 500 D, the latest version can be downloaded from the MACHEREY-NAGEL homepage under www.mn-net.com.

Follow the instructions given there.

2. Preparation for operation

Connect printer and PC, if this equipment is available. Switch on the photometer using key [%]. Once the system has performed the internal check-up, the photometer name, number and date of program version, current date and time as well as a symbol showing the state of charge of the battery, are displayed.

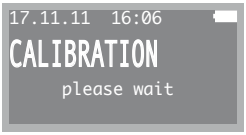
When **Method**:___ **/ >> cuvette >>** is displayed, the photometer is ready for operation. If <recharge batter> is displayed, connect the photometer to the charger / mains adaptor. Start the instrument again (the built-in battery is charged at the same time).

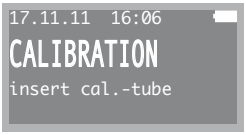
2.1 Calibration of the *NANOCOLOR*® 500 D

1. When you switch on the photometer, it performs a self-check.

2. After this self-check the method selection mode is activated.

3. If during the self-check the photometer measures a deviation, it asks for a new calibration. Start calibration with key [OK].





4. After calibration again the method selection mode is activated.

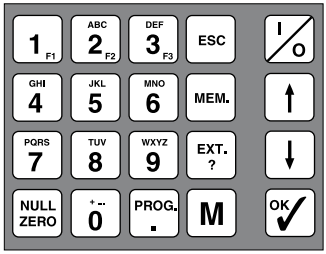
5. The calibration can be activated at any time from the configuration menu.

Filters which have left the confidence interval are displayed as <check filter> (repetition of the calibration, filter cleansing or filter change necessary). In order to prevent wrong measurements, further evaluation of tests which require the defective filter is blocked. If all filters are displayed as <error>, most probably the lamp is defective. Please contact MACHEREY-NAGEL.

3. Operation

3.1 Keyboard

The photometer *NANOCOLOR*® 500 D has a 20-part keyboard: 10 numbers and 10 keys with special functions. The whole field is covered with plastic foil and therefore protected against liquid spills. Tactile feedback for all keys increases safety of operation.



Explanation of individual keys

Key I/O	On/Off switch of the photometer
Keys 0 ... 9	For entering digits, letters or special characters
Keys F1 / F2 / F3	Double-function keys, for sample number, sampling location (alphanumeric) and dilution
Key PROG. .	For entering the decimal point method selection for special methods
Key ESC	Key for interrupt and return to method selection
Key ↑	Roll-mode upward key interrupt of the automatic program sequence / method selection / call up previous submethod / next program step / previous sampling location etc.
Key ↓	Roll-mode downward key interrupt of the automatic program sequence / method selection / call up next submethod / previous program step / next sampling location etc.
Key OK ✓	Enter key, for confirming any input, for confirming selected functions, after measurement call-up of correction measurement
Key MEM.	Key for calling up memory functions, for manually storing or suppressing the storage of recorded measurement values
Key EXT. ?	Call-up key for the extinction program, recalling the extinction after measurement, display of additional information
Key NULL ZERO	Manual zero adjustment
Key M	Measurement key The result is displayed. Consecutive measurements are numbered continuously.

3.1.1 Special functions of certain keys

[M] When the photometer has just been switched on, pressing key [M] calls up the last-used method.

[EXT. ?] Pressing key [EXT. ?] in method selection mode directly calls up the extinction program.

[MEM.] Pressing key [MEM.] in method selection mode calls up memory administration.

[PROG. .] Pressing key [PROG. .] in method selection mode calls up special (user-defined) methods.

[OK] When the photometer has just been switched on, pressing key [OK] displays the last stored value.

3.2 Measuring procedure

Characteristic test data

The characteristic data of all *NANOCOLOR*® tests are stored in the *NANOCOLOR*® 500 D. After the instrument is switched on and has reached the method selection mode, the desired methods can be activated by inserting the tube test (barcode tests) or by input of the 3-digit method number. The permanent programming of the *NANOCOLOR*® 500 D comprises all characteristic data of the desired test:

analytical parameter; factor; blank or base-line value; dimension; cuvette-dependent measuring range; wavelength; reaction time; linearity of the calibration; measuring direction

Method call-up

Many analytical parameters can be measured with different cuvette sizes, measuring ranges, dimensions and measuring wavelengths. The method can be called up in three possible ways:

1. Insert a barcoded tube test and select the characteristic data using the [↑] / [↓] keys. The required option is confirmed by pressing [OK].
2. Call up the method with 3 digits or using keys [↑] / [↓]. Again the characteristic data are selected using keys [↑] / [↓]. The desired option is confirmed by pressing [OK].
3. Select the desired option by calling up the 4-digit method number. Now the option cannot be changed with keys [↑] / [↓].

When activating a method for the first time, the required submethod has to be selected either with keys [↑] / [↓] and subsequent confirmation with key [OK] or by direct input of the fourth digit of the method number. When next calling up the main method, the photometer offers the last-used submethod (1st priority) and, if no other key is pressed, automatically activates it. If you wish to select another submethod, you can interrupt the automatic program sequence during a period of about 3 s by pressing keys [↑] / [↓] and then select the required submethod using keys [↑] / [↓] or by direct input of the fourth digit of the method number.

User guidance
The *NANOCOLOR*® 500 D now governs the further course of the measurement by optical display instructions:

measuring range and dimension, reaction time, zero adjustment, sample number, sampling location, dilution and readiness to measure any number of samples
If the measuring range is exceeded, or if any other errors arise, these will be indicated on the display immediately.

Measuring ranges
For each test, the measuring ranges specified in the manual are stored in the *NANOCOLOR*® 500 D. When the measuring result exceeds or falls short of the measuring range, the respective limit is displayed and stored with either the symbol > or <. Dilution is taken into account automatically.

Sample number
When pressing key F1 after a measurement, as long as the cuvette is still in the cuvette slot, you can assign a 4-digit sample number to the respective measuring value. After the input this number is displayed in the lower status line. When you remove the cuvette, the sample number is stored together with all other measurement data.

Sampling location
When pressing key F2 after a measurement, as long as the cuvette is still in the cuvette slot, you can assign a 12-character alphanumeric name for the sampling place. After input this name is displayed in the lower status line (please note that, although 12 characters are stored, max. 10 characters can be shown in the display). If you have previously defined any sampling locations, you can use keys ↑ / ↓ to select from a list of the last 20 names. When you remove the cuvette, the name of the sampling place is stored together with all other measurement data.

Dilution
When pressing key F3 after a measurement, as long as the cuvette is still in the cuvette slot, you can assign a dilution factor to the measuring value, which is directly after input used to calculate the correct result. When you remove the cuvette, the dilution factor is stored together with all other measurement data.

Change of dimension
The dimension cannot be changed during the measurement sequence. In this case you have to start a new method selection.

Cuvette change
When a different measuring range requires a change of the cuvette size, a one-time zero adjustment for the respective cuvette is necessary. As long as you do not leave the method, you may then change between cuvette sizes without any further zero adjustment.

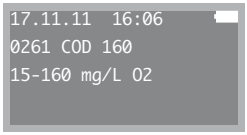
3.3 Scheme of operation for *NANOCOLOR*® tests

3.3.1 Scheme of operation when using tube tests with barcode

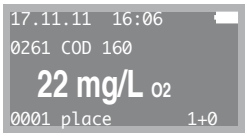
desired parameter: e.g. COD 160 test 0-26

1. Key [ESC] (if other parameters have been measured before)

2. Insert coded test tube into the photometer.
   Display of measuring range



3. The interference filter is automatically turned into measuring position and the cuvette is measured immediately.



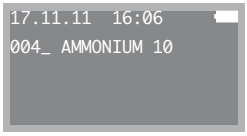
4. If desired, place other sample test tubes in photometer and measure; samples are numbered in sequence.

3.3.2 Scheme of operation when using tube tests with or without barcode or for manual operation

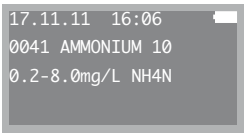
desired parameter: e.g. Ammonium 10 Test 0-04

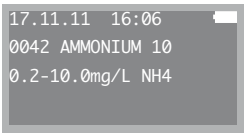
1. Key [ESC] (if other parameters have been measured before)

2. Insert coded test tube into the photometer or enter test number, keys [0] [0] [4]



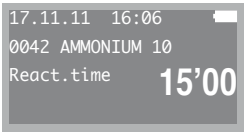
3. Press key [↑] first measuring range is displayed with dimension; press key [↑], until required measuring range and dimension appear (can be repeated endlessly in roll mode or back with key [↓]).



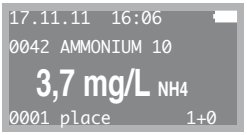


This can also be attained if the fourth digit of the 4-digit test number, e.g. [ABC 2], is entered straight away.

4. Confirm required measuring range and dimension by pressing key [OK] (does not apply when 4 digits are entered). The interference filter is automatically turned into measuring position.
5. Reaction time is displayed. When using test tubes with barcode, reaction time starts automatically.

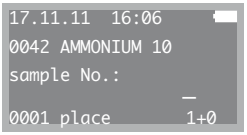


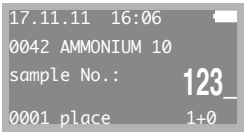
6. Place test tube with sample in photometer, start reaction time with key [OK] or skip with key [↑].
The test tube with base line value (NULL) is not used.



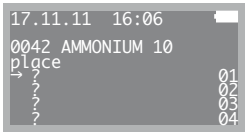
If a ✔ is displayed in the upper status line between time and battery indicator, automatic storage of results is activated (see Configuration chap. 3.5.3). This means, that the respective result is automatically stored when the cuvette is removed from the photometer. If you do not want to store the result, just press key [MEM], and this value is not stored. On the other hand, if storage is deactivated, the actual result can be stored by pressing key [MEM].

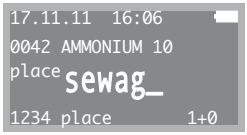
7. For entering a sample number press key [F1]. A sample number may have up to 4 digits.



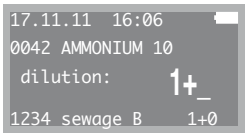


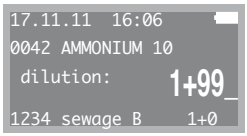
8. For entering a sampling place press key [F2]. The name of a sampling location may have up to 12 alphanumeric characters. Up to 20 places are stored in a list and can be selected or edited using keys [↑] / [↓]

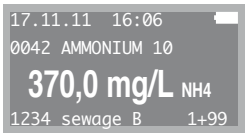




9. For entering a dilution press key [F3]. The dilution is entered as 1 + x, i. e. a dilution of 1 : 100 is entered as 1 + 99. After input the dilution is directly used to calculate and display the correct result.







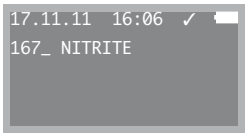
10. If necessary, place other test samples in photometer and measure; samples are numbered in sequence. Current sample number, place and dilution are always displayed in the lower status line.

3.3.3 Scheme of operation for standard tests

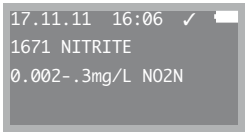
desired parameter with reagent blank value: e.g. Nitrite Test 1-67

1. Key [ESC] (if other parameters have been measured before).

2. Enter test number, keys [1] [MNO 6] [PQRS 7].



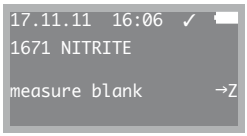
3. Press key [↑], the first measuring range is displayed with dimension; press key [↑], until required measuring range and dimension appear (can be repeated endlessly in roll mode or back with key [↓]).



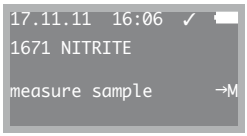
This can also be attained if the fourth digit of the 4-digit test number, e.g. [1], is entered straight away.

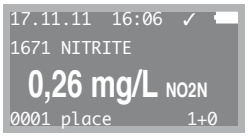
4. Confirm required measuring range and dimension by pressing key [OK] (does not apply when 4 digits are entered). The interference filter is automatically turned into measuring position.
5. Reaction time is displayed, start with key [OK] or skip with key [↑].

6. Place cuvette with blank value in photometer and press [NULL ZERO] for zero adjustment (use same cuvette size as for sample, e.g. 10 mm).



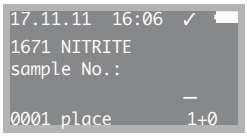
7. Place rectangular cuvette with sample in photometer and measure by pressing key [M].

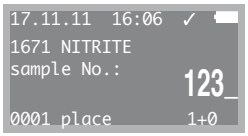




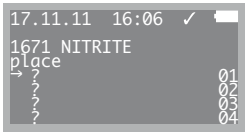
If a ✔ is displayed in the upper status line between time and battery indicator, automatic storage of results is activated (see Configuration chap. 3.5.3). This means, that the respective result is automatically stored when the cuvette is removed from the photometer. If you do not want to store the result, just press key [MEM.] and this value is not stored. On the other hand, if storage is deactivated, the actual result can be stored by pressing key [MEM.]

8. For entering a sample number press key [F1]. A sample number may have up to 4 digits.

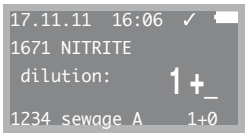


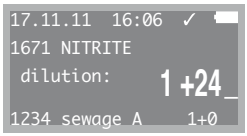


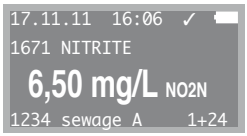
9. For entering a sampling place press key [F2]. The name of a sampling location may have up to 12 alphanumeric characters. Up to 20 places are stored in a list and can be selected or edited using keys [↑] / [↓].



10. For entering a dilution press key F3 drücken. The dilution is entered as 1 + x, i. e. a dilution of 1 : 25 is entered as 1 + 24. After input the dilution is directly used to calculate and display the correct result.



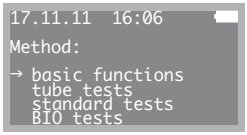


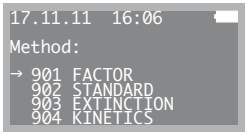


11. If necessary, place other test samples in photometer and measure; samples are numbered in sequence. Current sample number, place and dilution are always displayed in the lower status line.

3.4 Basic photometric functions

By calling up method **9xx** or using keys ↑ / ↓ you can access basic photometric functions. Select the required option in the roll mode and confirm with key OK.





3.4.1 901 FACTOR

Since the color reactions normally used for measurements obey the Lambert-Beer Law (E = ε x c x d), the photometer can be calibrated by using a factor.

concentration = extinction x factor

The above applies only to the limited range specified for every test. Test results, which exceed this range, should be repeated after dilution of the test sample. Test results, which are below the range can be repeated using a cuvette with longer optical path using a new factor or must be recorded as ”smaller than lower range limit“ (e.g. < 0.05 mg/L). Should a test method not conform to the Lambert-Beer Law, then the concentration can only be determined by measuring the extinction and reading the result from a conversion table. At this point we would like to refer to the PC software *NANOCOLOR*® Data Export (REF 919 02), which allows calculation of factors and polynomials for development of user-defined methods.

Measurement with factor

1. Select method 901
2. The preset wavelength is displayed. Select the required wavelength using keys [↑] / [↓] and confirm the selection by pressing [OK]. The selected wavelength is automatically adjusted.
3. Enter factor via keyboard. The accuracy of the display is determined by the number of decimal places of the factor.
4. Perform measurement following the instruction of the display. (After measurement, as long as the cuvette is still in the cuvette slot, the extinctions can be displayed by pressing [EXT. ?].)
5. Return to method selection using key [ESC].
   The factor is erased.

3.4.2 902 STANDARD

There are certain determinations, where the color reaction strongly depends on different parameters, such as temperature, time or concentration of the reagents (e.g. medications). In such cases it is necessary to analyze a standard with a known concentration, as well as the test sample. The test results are then related to those of the standard. The Lambert-Beer Law ($E_1 : \beta_1 = E_2 : \beta_2$), must apply here once again as follows:

$$\text{unknown concentration} = \text{concentration of standard} \cdot \frac{\text{extinction (test sample)}}{\text{extinction (standard)}}$$

Measurement with standard

1. Measurement with standard 902
2. The preset wavelength is displayed. Select the required wavelength using keys [↑] / [↓] and confirm the selection by pressing [OK]. The selected wavelength is adjusted.
3. Enter concentration of the standard via the keyboard. The accuracy of the display is determined by the number of decimal places of the standard concentration.
4. Perform measurement following the instruction of the display. (After measurement, as long as the cuvette is still in the cuvette slot, the extinction can be displayed by pressing [EXT. ?].)
5. Return to Method selection using key [ESC].
   The standard concentration is erased.

3.4.3 903 EXTINCTION

The extinction is a basic term in photometry, upon which all other definitions are based.

$$\text{extinction} = \text{logarithm}\left(\frac{\text{light transmitted through blank value}}{\text{light transmitted through test sample}}\right)$$

The practical *NANOCOLOR*® analytical system gives direct reading of results. In spite of this fact, and especially in cases where the test results are near the limits of the range, extinction should not be ignored, since the four digit display does not offer any information about accuracy and consistency of test results. In photometry, the desired absorbance range lies between 0.1–1.0 extinctions. The extinction of a test sample can also be called up during other measurement programs.

Negative extinctions are found for methods where a color decrease is used for the measurement.

Measurement of extinction

1. Select method 903 or directly press key [EXT, ?].
2. The preset wavelength is displayed. Select the required wavelength using keys [↑] / [↓] and confirm the selection by pressing [OK]. The selected wavelength is adjusted.
3. Perform measurement following the instruction of the display.
4. Return to method selection using key [ESC].

3.4.4 904 KINETICS

For following the color development (reaction) with time, the kinetics program offers the possibility of repeating the measurement at defined time intervals, and to store and print results.

Measurement of kinetics

1. Select method 904.
2. The preset wavelength is displayed. Select the required wavelength using keys [↑] / [↓] and confirm the selection by pressing [OK]. The selected wavelength is adjusted.
3. Enter factor via the keyboard. The accuracy of the display is determined by the number of decimal places of the factor. (For measurement of extinctions enter factor = 1.000.)
4. Set time interval (between 00’10 and 60’00 min) and confirm by pressing [OK].
5. Perform measurement following the instruction of the display.
6. Finish the measuring sequence by removing the cuvette. If required insert another cuvette into the photometer and start a new sequence by pressing [M].
7. Return to method selection using key [ESC].

3.4.5 905 TRANSMISSION

In addition to the absorbance, transmission is a very significant variable in photometry. Transmission is the transparency of a sample solution to the light used for measurement. The transmission is expressed directly as percentage.

$$\text{Transmission in \%} = \frac{\text{light transmited through test sample}}{\text{light transmited through blank value}} \times 100$$

The dimensionless variable $\frac{\text{light transmited through test sample}}{\text{light transmited through blank value}}$ is referred as the transmittance.

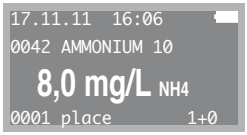
Measurement of transmission

1. Select method 905.
2. The preset wavelength is displayed. Select the required wavelength using [↑] / [↓] keys and confirm the selection by pressing [OK]. The selected wavelength is adjusted.
3. Perform measurement following the instruction of the display.
4. Return to method selection using key [ESC].

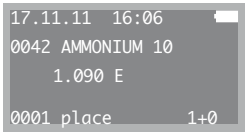
3.5 Special functions

3.5.1 Display of extinction

After measurement

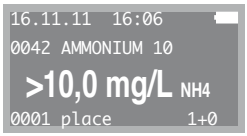


the extinction of the measured value can be displayed by pressing [EXT. ?].

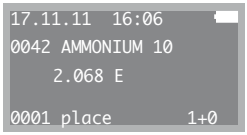


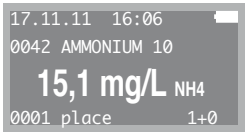
Display of extinction, when the measuring range is exceeded

After measurement



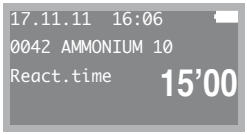
the extinction of the measured value can be displayed by pressing [EXT. ?]. When releasing key [EXT. ?], the calculated measuring value is displayed. This estimated value is not stored; in the above example > 10,0 mg/L NH4 will be stored.





3.5.2 Reaction time

If you wish, the reaction time can be displayed before measurement. Press key [OK ✓] to start the clock.

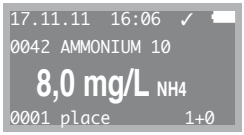


The reaction time can be skipped or stopped at any time using key [↑] or [M].

After completion of the reaction time the sample is measured **automatically**, if there is a cuvette in the cuvette slot. The configuration menu allows to completely activate or deactivate the reaction timer.

3.5.3 Memory administration

In the standard mode of operation storage is activated (indicated by a ✔ between time and battery display.



As long as the cuvette is still in the cuvette slot, pressing key MEM. when storage is **deactivated** will store the current measuring result, vice versa when storage is **activated** pressing key MEM. will suppress storage of the current value.

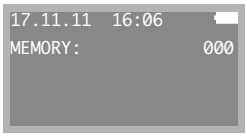
If the display reads <memory full>, you have stored 500 data sets. You can either accept this message by pressing OK ✓ and continue measurements without storage, or you can call up the memory administration by pressing key MEM., transfer the contents of the memory to a computer, e.g. with the data export program, and then clear the memory of the photometer.

The configuration menu also allows to deactivate storage completely.

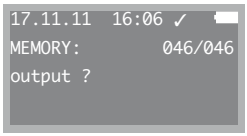
Data handling

For memory administration press key MEM. in method selection mode.

The display will read either



or, if any measuring values are stored, e.g.



The memory administration offers several options for handling data. Using keys ↑ / ↓ you can select one of the above options.

Printing and output

When you press key [OK] at this point, all stored data are transferred via the 9-pin serial interface to a ready serial printer to be printed.

(Make sure that the transfer rates of printer and photometer are set to the same values, e.g. 9600 baud, no parity, 8 data bits, 1 stop bit, no protocol.)

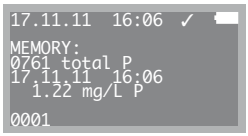
If a PC is connected via serial or USB cable, data can also be transferred to an external terminal programme.

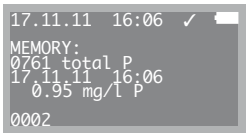
For convenient handling of the data transfer we recommend the MACHEREY-NAGEL programme „Photometer Data Export“, REF 919 02.

The photometer has to be in method selection mode and the data transfer is controlled by the programme either via serial or USB connection.

Display

When you press key [OK] at this point, you can display all data sets in sequence using key [↑] . If you have previously made a selection only the selected data sets are displayed.

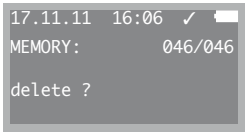




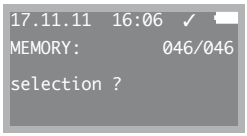
Using key [↓] you can return to the last-displayed value. With key [MEM.] and confirmation with [OK] you can delete any data set. Pressing key [OK] the displayed data set is transferred to the interfaces.

Deleting data

When you press key [OK] at this point, and confirm deletion by pressing [OK] once more, the selected data or – as in the case below – all data sets are deleted from the memory.



Selecting data

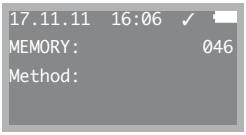


The following options for selection are available:

method number / sampling location / date / time

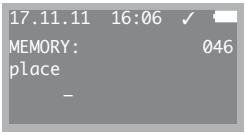
When you press key [OK] at this point, you access the selection mode.

Enter the required **method**.



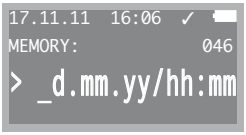
When the method is entered with four digits, all data belonging to the specific submethod are selected. When you enter 3 digits of the method number, all submethods of this test (e.g. 0041–0049) are selected. Input of a method number can be skipped by pressing [OK].

In this case all tests are selected, or you skip selection by method using key [↑] and access the next selection step **sampling location**.



At this point you can enter the alphanumeric name of the sampling location with up to 12 characters and confirm by pressing [OK] When you enter less characters, the instrument selects all names starting with this character string. In this case it does not matter whether you enter upper case letters or lower case letters. Here again, you can skip the selection using key [↑] to reach the next option:

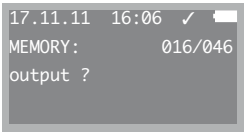
Date and time



At this point you can first enter the starting point and then the end point of the time interval for selection.

Again you can skip this option using key [↑]. This ends the selection procedure.

Immediately after finishing the selection the result is displayed.



Now selected values can be transferred to a computer or serial printer, displayed or deleted.

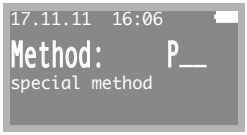
If there are no data sets meeting the selection criteria, for further handling all data sets are again available (046/046).

3.5.4 Special (user-defined) methods

The *NANOCOLOR*® 500 D offers the possibility to program up to 100 user-specific methods. These methods can be defined as linear (factor) or as non-linear methods (up to 4th degree functions). For defined methods the same options are available as for the pre-programmed methods (i. e. sampling location, dilution, storage etc.).

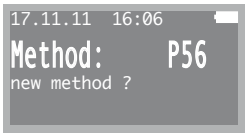
Selection of a special method

Special methods are activated from the main menu by pressing PROG.



New method

Call up new method – for example P56 – by pressing key PROG. and 56.



Now the method parameters can be entered. For entering text, selection of filter, cuvette size, factor, measuring direction and range, dimension incl. supplement and reaction time, every letter or number can be entered directly via the keyboard.

When the display asks <factor linear ?>, you can either press key OK and enter a linear factor ($\beta = E \times F$) where the position of the decimal point of the factor determines the number of decimals of the display, or you can press keys ↑ / ↓ and enter a polynomial up to the 4th order ($\beta = F_4 \times E^4 + F_3 \times E^3 + F_2 \times E^2 + F_1 \times E + F_0$). Pressing key ↓ **before** entering any of the polynomial factors changes the sign of the respective term. **After** all terms of the polynomial have been entered, the number of decimals for the display and the measuring direction (+ = increasing, – = decreasing, ± = both directions) are entered.

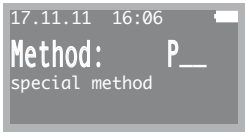
At any time, a wrong entry can be deleted using key ↓ and then corrected. Also, by pressing ESC, programming can be aborted at any time.

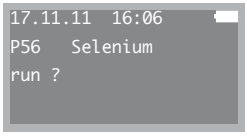
After pressing PROG. and entering the two digits for a programmed user-defined method, you can select several options in the roll mode using keys ↑ / ↓.

Running a special method

Entering the 2-digit number, e.g. P**56**, activates a previously defined special method.

If you do not remember the number of a special method, you can use keys [PROG.] and then [↑] / [↓] to scroll through all user-defined methods.

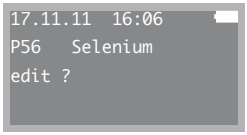




After confirmation with [OK] the measuring sequence is started.

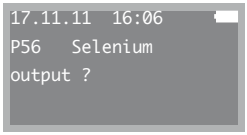
Editing a special method

Using keys [↑] / [↓] / you access the submenu <edit>. After confirmation with [OK] all previous entries can be edited.



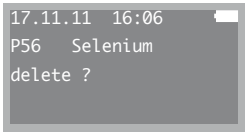
Output

Using keys [↑] / [↓] you access the submenu <output>. After confirmation with [OK] all previous entries can be transferred to a PC using either the serial or the USB interface. Output to a serial printer is possible via the serial interface.



Deleting a special method

Using keys [↑] / [↓] you can access the submenu <delete>. After selection with key [OK] and another confirmation the current method can be deleted.



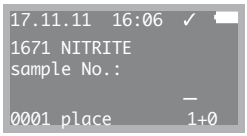
Note

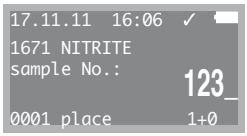
Output of a list of all user-defined methods to the serial interface is possible by pressing keys [PROG.] and [MEM.] in sequence.

3.5.5 Numbering of samples

For an unambiguous identification of samples, every measurement is automatically assigned a sample number (starting with **0001**). Further measurement values are numbered in sequence. It is possible to assign another sample number to each value directly after measurement. Before you remove the cuvette from the cuvette slot, press key F1 and enter the 4-digit sample number.

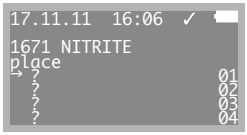
After entering the sample number it is displayed in the lower status line together with all other parameters of this data set. When you remove the cuvette, the complete data set is stored. Subsequent measurements are continuously numbered starting with the entered value. A subsequent data processing step can assign a sample name for a given sample number. Generally, numbering of samples starts with **0001** after every method selection.

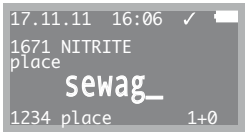




3.5.6 Identification of sampling locations

For differentiating sampling locations it is possible, after measurement, and before the cuvette is removed, to enter an alphanumeric place name (up to 12 characters). Before removing the cuvette from the cuvette slot, press key F2 and type the name. After input the place is displayed in the lower status line together with all other parameters of the current data set. If you have previously defined any sampling locations, after pressing key F2 you can use keys ↑ / ↓ to select from or edit a list of the last 20 names. When you remove the cuvette, the complete data set is stored.





3.5.7 Dilution of samples

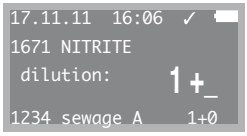
In analytical practice it is often necessary to dilute a sample, until the concentration to be determined is within the measuring range.

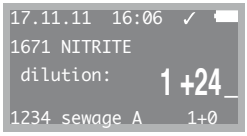
Example:

expected measurement value:	between 80 and 200 mg/L
range of photometric test:	0.1–10.0 mg/L
required dilution	(200 → 10 mg/L): at least 1 : 20
recommended dilution:	1 : 25 or even 1 : 50 in order to obtain a result in the middle of the measuring range

Input of a dilution is as 1 part sample **plus** x parts dist. water, in order to obtain unambiguous identification of small dilutions, too. It is possible to enter dilutions from 1 + 1 to 1 + 999.

Before you remove the cuvette from the cuvette slot, press key F3 and enter the dilution. After input the dilution is displayed in the lower status line together with all other parameters of the current data set, and the resulting measuring value is directly calculated and displayed. When you remove the cuvette, the complete data set is stored.

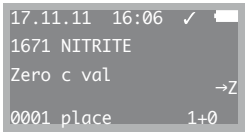




Please note: any entered dilution only concerns the current measurement. For very large dilutions, e.g. 1 + 999, the result may be displayed in a different dimension in order to be presentable.

3.5.8 Automatic determination of a correction value

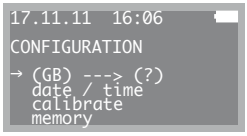
Turbid or colored samples require preparation of a correction value. After normal evaluation (with coloration/turbidity) measurement of the correction value is activated by pressing OK. The programme asks for a cuvette with the correction value (see chapter 5.11), which is then measured. The corrected measuring result is displayed and stored, when the cuvette is removed.

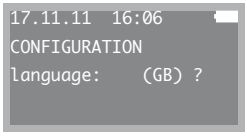


3.6 Configuration of the *NANOCOLOR*® 500 D

In method selection mode enter [9] [0] [0]. All topics of the configuration can be selected in the scroll mode using keys [↑] / [↓].

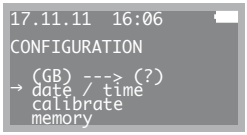
1. Select language and confirm with [OK].

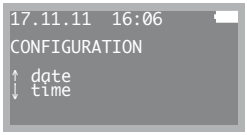




Wait until your language is displayed, then press key [OK] until confirmation appears. You can choose between deutsch (D), english (GB), français (F), italiano (I), nederlands (NL), español (E), magyar (H), polski (PL), português (P), esky (CZ), baha indonesia (INA) and slovensko (SLO).

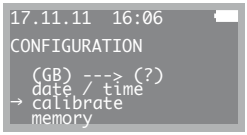
2. Select date / time and confirm with [OK].

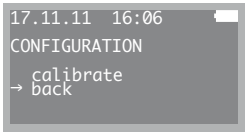


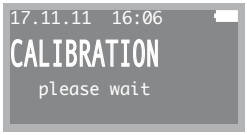


With keys [↑] / [↓] select date or time and adjust using the keyboard.

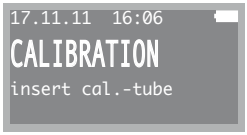
3. Select calibration and confirm with [OK].

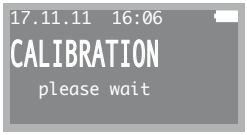




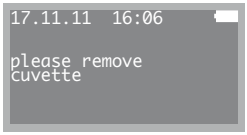


First the photometer automatically checks all filters and the lamp. For the second calibration step the *NANOCOLOR*® 500 D requires a calibration tube (a clean *NANOCOLOR*® 500 D test tube filled with water).

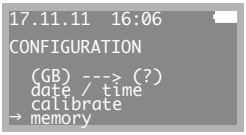


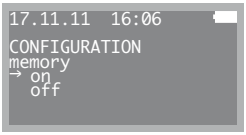


The calibration values are automatically measured, stored and used for all following measurements



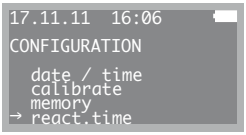
4. Select memory and confirm with [OK].

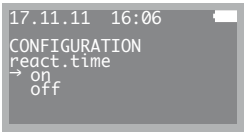




Using keys [↑] / [↓] turn memory on or off and confirm with key [OK].

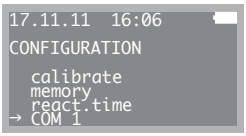
5. Select reaction time and confirm with [OK].

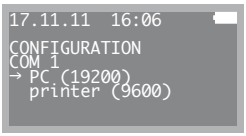


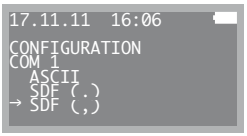


Using keys [↑] / [↓] turn reaction time on or off and confirm with key [OK].

6. Select interface and confirm with [OK].





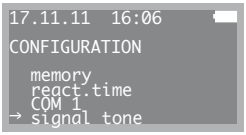


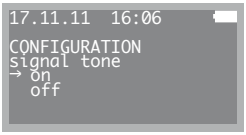
Adjust the parameters of the serial interface RS 232 in scroll mode using keys [↑] and [↓] and confirm every setting with key [OK].

The following options are possible:

PC (19200) or 9600 (printer); and when you select PC: ASCII or SDF (semicolon delimited format) with decimal point (.) or decimal comma (,)

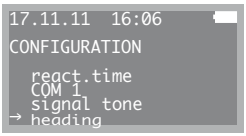
7. Select signal tone and confirm with [OK].





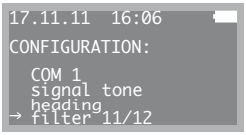
Using keys [↑] / [↓] turn signal tone on or off and confirm with key [OK].

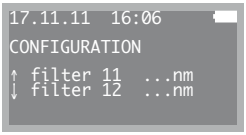
8. Select heading and confirm with [OK].



Using keys [↑] / [↓] you can edit the heading or you may enter a new heading using the keyboard of the photometer.

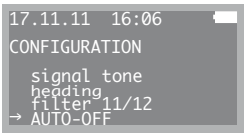
9. Select special filters 11 and 12 and confirm with [OK].

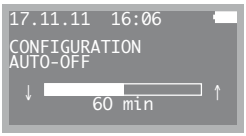




Using keys [↑] / [↓] select position 11 or 12. Enter the wavelength(s) of the additional special filter(s) via the keyboard.

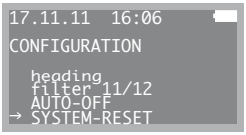
10. Select AUTO-OFF and confirm with [OK].

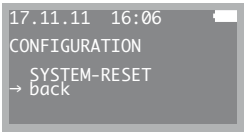




Using keys [↑] / [↓] you can determine the turn-off time of the photometer after the last measurement. Available times run from 10 to 120 min in 10-minute intervals (ex factory = 20 min). Confirm your setting with [OK].

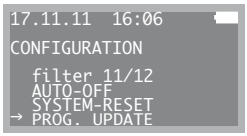
11. Select SYSTEM-RESET and confirm with [OK].

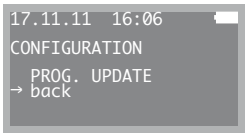




After a second confirmation the photometer performs a SYSTEM-RESET, thus restoring the state of delivery, i. e., the complete memory, all user-defined special methods etc. are delete. The display then asks for a calibration. Confirm with [OK] and perform the calibration.

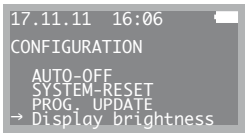
12. Select PROG. UPDATE and confirm with [OK].

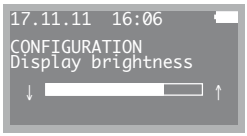




In order to perform a programme update, you must first install the update software and the new programme file (www.mn-net.com) on a computer. Before you start the update procedure the photometer has to be connected to the computer either via the serial or the USB interface. Start the update programme on the PC and on the photometer. After a successful update the photometer returns to the method selection mode.

13. Select display and confirm with [OK].





At this point you can use keys [↑] / [↓] to adjust the luminance of the display in several steps.

3.7 Data transfer

The *NANOCOLOR*® 500 D can communicate with almost any conventional terminal software.

For this purpose it features choice of two different interfaces:

– Serial RS 232 standard interface

– USB port 1.1

For data transfer you need either a serial zero modem cable (9/9 pins, REF 919 680) or a standard USB cable (plug A / plug A).

***NANOCOLOR*® software Photometer Data Export (REF 919 02)**

This programme governs the complete communication with the photometer, transferred data can be immediately processed as MS Access data base or as MS Excel spreadsheet.

For further information see www.mn-net.com.

Alternative data processing

Terminal software

You may e.g. use the native Windows® software Hyperterminal.

For serial transfer it is important to match the transfer rate between photometer and computer. Basic setting: 19200 baud, 8 data bits, no parity, 1 stop bit, no protocol. The configuration has to be adjusted in the photometer as well as in the terminal software.

Transfer of stored data from the photometer

Switch on the photometer, and call up memory administration by pressing MEM. If required, select data to be transferred. When confirming the option **<output ?>** transfer to the computer is started.

On-line measurements

Each measured data set is sent to the interfaces, when the cuvette is removed from the photometer.

Data transfer formats

ASCII	output of data is in the tab delimited format
SDF	(semicolon delimited format), fields of a data set are separated by semicolons and can thus easily be imported in spread sheets.
SDF(.)	selection of a decimal point
SDF(,)	or a decimal comma for transferred data.

3.8 Troubleshooting

Message	Explanation	Suggested remedy
recharge battery	battery voltage is below the minimum	recharge battery with the charger for about 14 h; photometer can be operated during charging
memory full	the memory of the photometer contains the maximum of 500 data sets	accept message by pressing OK and continue measurements without storage or in the method selection mode call up memory administration by pressing MEM., transfer and then delete the contents of the memory. If required, storage can be completely deactivated in the configuration mode.
calibrate?	deviation(s) found during self-check	start calibration by pressing key OK
check filter	serious deviation(s) found during self-check or calibration	restart calibration from the configuration menu. If error remains, contact your local distributor for filter replacement
lamp defective	no light at the photo cell	if necessary, replace lamp, then recalibrate system
please remove cuvette	cuvette in the optical path at a wrong time no cuvette in the beam	scanner did not recognize cuvette, remove cuvette and insert again cuvette without barcode, manual operation required (see chapter 3.3.2) cuvette control defective
check: cuvette	method and cuvette size do not correspond	select proper method or proper cuvette
check: >->>->>>	too much light at the photo cell	have the instrument adjusted
check: <-<<-<<<	no light at the photo cell	sample solution too dark filter defective lamp defective
photometer does not respond although it is switched on	system hangs	press reset push button in the back of the instrument; then switch on again.

4. Preparation of samples

Water samples are not always suitable for immediate analyses. In the case of heavily polluted water (or waste water) especially, it is often not possible to conduct analyses without pretreating the sample first; otherwise, larger concentrations of organic or inorganic compounds can interfere and lead to falsely negative or positive test results.

Some of the following preparations may be necessary before analyzing the water (examples in brackets):

1. dissolve undissolved compounds (metal oxides)
2. release complex or adsorptive compounds (hexacyanoferrates)
3. decompose polymer compounds (polyphosphates)
4. change the state of oxidation (Cr(III) → Cr(VI))
5. remove interfering substances (nitrite in the case of nitrate determination)
6. separate the substance to be determined by distillation (ammonium, cyanide)
7. eliminate organic substances (waste water)
8. filter turbid and suspended matter (sedimentation); e.g. with membrane filters

We offer a number of methods for sample pretreatment:

The crack set (REF 918 08) and *NANOCOLOR® NanOx* are used for oxidative treatment of the sample in an acidic medium under normal pressure at 100–120 °C. These methods feature easy handling and solve a large number of decomposition problems.

For samples with difficult matrices, but especially for rapid determination of *total* nitrogen, *total* phosphorus and *total* chromium, we recommend oxidative decomposition with *NANOCOLOR® NanOx* at elevated pressures in a microwave oven.

Very resistant samples (applicable to points 1, 2, 3, and 7 above) can be treated by wet decomposition (oxidation) with nitric and sulfuric acid:

Instructions: add 50 mL of sample, 2 mL nitric acid (65 %) and 2 mL sulfuric acid (96 %) to a beaker, heat almost to dryness (use fume cupboard with fan on). As soon as a white SO_3 fog appears, stop heating and allow the deposit to cool down to room temperature, then add 20 mL distilled water. Neutralize with sodium hydroxide solution and pour sample into a volumetric flask 50 mL, rinse out the beaker twice with 10 mL distilled water each time and pour into the volumetric flask. Then fill the volumetric flask to the 50 mL mark with distilled water. Almost all metals can be determined directly in this solution.

Depending on the specific problems, this method has to be adjusted or replaced by another sample preparation method. It should always be kept in mind, that on the one hand, when the sample preparation is completed, a defined volume of sample must be present, in order to be able to make an exact statement about the concentrations obtained once the actual analysis is finished. On the other hand, the original chemical milieu of the sample has to be reestablished (pH value, redox potential etc.) according to the specific requirements of the analytical method.

As can be deduced from this concise explanation, each analysis has to be individually treated and the sample accordingly prepared in the case of polluted samples. Only then can accurate and realistic test results be achieved. Please contact us should you have any questions.

4.1 Crack Set

Method: Dissolution and decomplexation of heavy metals with sulfuric acid and potassium peroxodisulfate

NANOCOLOR® reagent set: Crack set (REF 918 08)

Requisite accessories: *NANOCOLOR*® heating block, decomposition apparatus (REF 916 29), piston pipette with tips

Precautions: *Beware of samples containing high concentrations of cyanides – poisonous vapours will develop!*

Procedure: Switch on heating block, set to 100 °C and 1 h 00 min.

Fill decomposition tube with **10 mL** homogenized sample, add **1 mL** R1 and **1 level measuring spoon** R2, shake slightly, attach absorption tube and place decomposition tube into the heating block, press **START** key.
After 1 h remove decomposition tube from heating block, cool, add **1 mL** R3 and mix. *The pH value should be between a pH of 2 and 5, otherwise add more or less R3.*

A. Tube tests

The decomposed solution can be used directly for the test. Insert test tube and select method number according to the following table:

			Method
Lead 5	test 0-09	0.10–5.00 mg/L Pb	**0093**
Cadmium 2	test 0-14	0.10–2.00 mg/L Cd	**0143**
Iron 3*	test 0-37	0.10–3.00 mg/L Fe	**0373**
Copper 7	test 0-54	0.10–7.00 mg/L Cu	**0543**
Nickel 7	test 0-61	0.10–7.00 mg/L Ni	**0613**
Zinc 4	test 0-96	0.10–4.00 mg/L Zn	**0963**

B. Standard tests

Pour decomposed solution into a volumetric flask 25 mL, rinse decomposition tube with some distilled water and fill flask to about 20 mL with distilled water (corresponds to the 20 mL sample volume mentioned in the test procedures). Measure according to original procedures. **Multiply results by 2!**

Suited for: Iron* test 1-36, Cobalt test 1-51, Copper test 1-53, Nickel test 1-62, Zinc test 1-95.

* An exact determination of iron requires a reagent blank value, because even analytical grade chemicals may contain traces of Fe.

C. Extraction methods

Pour decomposed solution into a separation funnel 100 mL and rinse decomposition tube with about 40 mL distilled water (corresponds to the 50 mL sample solution mentioned in the procedures). Measure according to original procedures. **Multiply results by 5!**

Suited for: Lead test 1-10, Cadmium test 1-13.

4.2 *NANOCOLOR*® *NanOx* Metal

for oxidative decompositon of metals and *total* phosphorus

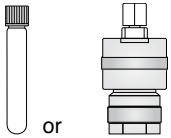
***NanOx* Metal: *NanOx* decomposition reagent and *NanOx* neutralization reagent**

Principle: Oxidative decomposition for determination of complexly bonded metals or metal ions, which are present in an oxidation state, which without decomposition would not be determined by the test (e.g. chromium(III)). Also suitable for the determination of *total* phosphorus by oxidation of all inorganic and organic phosphorus compounds to form *ortho*-phosphate.

Application:

Decomposition in a heating block: the decomposition in a heating block at 100–120 °C features a lower oxidation potential than microwave decomposition. For mainly industrial waste waters this method can be used if the matrix is constant over a longer time period. In regular intervals the applicability of the method should be checked against a reference procedure (e.g. microwave decomposition).

Pressurised microwave decomposition: this method features the advantages of easy handling and considerable time-saving.



Decomposition with *NANOCOLOR*® *NanOx* Metal

Method:	Acid oxidative pressurised heating block or microwave decomposition followed by neutralization
NANOCOLOR® reagent set:	*NANOCOLOR*® *NanOx* Metal (REF 918 978)
Requisite accessories:	*NANOCOLOR*® heating block, test tubes 14 mm ID (REF 916 80) or alternatively: microwave oven, PTFE pressure vessel 20 mL for decomposition and safety expansion reservoir (REF 916 40)
Note:	*We recommend to read the instructions for use, which come with the NanOx reagent set, before you start practical work. They contain further important details.*

Procedure heating block:

Pipet **5.0 mL** test sample into an **empty** reaction tube 14 mm ID (REF 916 80) add **1 level orange measuring spoon *NanOx* Metal decomposition reagent**, close and shake thoroughly. Place the reaction tube into the heating block and heat 30 min at 120 °C or 1 hour at 100 °C. Remove tube from the heating block, shake lightly and let cool. **The decomposition solution must be clear and colorless.** Otherwise another decomposition is necessary. Open the reaction tube and test the decomposition solution for peroxides using *QUANTOFIX*® Peroxide 25 test strips (REF 913 19). If peroxides are present, close tube and heat again without further addition of *NanOx* Metal decomposition reagent. Remove from the heating block and let cool for about 10 min. Turn the reaction tube on its head once, open it and again test for peroxides. Then carefully (evolution of gas) add **3 level microspoons *NanOx* neutralization reagent**, close and shake thoroughly. The pH value must be between pH 3–7, otherwise add more neutralization reagent.

Procedure microwave:

Pipet **10 mL** sample solution into the decomposition vessel, add **2 level orange measuring spoons *NanOx* Metal decomposition reagent**, close and shake thoroughly. Place pressure vessel on the outer rim of the turntable in the microwave oven and heat 23 s at 900 VA or 28 s at 750 VA (always use the highest setting of the respective instrument). Remove vessel from the microwave oven and let cool for about 10 min. Turn the pressure vessel upside down once and open it with caution. **The decomposition solution must be clear and colorless.** Otherwise another decomposition is necessary. Test the decomposition solution for peroxides using QUANTOFIX® Peroxide 25 test strips (REF 913 19). If peroxides are present, close vessel, and microwave again without further addition of *NanOx* Metal decomposition reagent. Remove from the microwave oven and let cool for about 10 min. Turn the pressure vessel on its head once, open it and again test for peroxides. Then carefully (evolution of gas) add **6 level microspoons *NanOx* Metal neutralization reagent**, close and shake thoroughly. The pH value must be between pH 3–7, otherwise add more neutralization reagent.

A. Tube tests

The decomposed solution can be used directly for the determination. Insert test tube and select method according to the following table:

			Method
Aluminium 07*	test 0-98	0.02 – 0.70 mg/L Al	**0982**
Cadmium 2	test 0-14	0.10 – 2.00 mg/L Cd	**0142**
Chromate 5	test 0-24	0.05 – 2.00 mg/L Cr	**0244**
(Chrome)		0.005 – 0.50 mg/L Cr	**1244**
Iron 3	test 0-37	0.10 – 3.00 mg/L Fe	**0372**
Copper 7	test 0-54	0.10 – 7.00 mg/L Cu	**0542**
Nickel 7	test 0-61	0.10 – 7.00 mg/L Ni	**0612**
Phosphate 1	test 0-76	0.05 – 1.50 mg/L P	**0761**
Phosphate 5	test 0-81	0.20 – 5.00 mg/L P	**0811**
Phosphate 15	test 0-80	0.30 – 15.00 mg/L P	**0801**
Phosphate 45	test 0-55	5.0 – 50.0 mg/L P	**0551**
Phosphate 50	test 0-79	10.0 – 50.0 mg/L P	**0791**
Zinc 4	test 0-96	0.10 – 4.00 mg/L Zn	**0962**

B. Standard tests

Pour the decomposed solution into a volumetric flask 25 mL, rinse decomposition vessel or reaction tube with some distilled water and fill flask to about 20 mL with distilled water (corresponds to the 20 mL sample volume mentioned in the test procedures). Measure according to original procedure and **multiply results by 4 (heating block) or 2 (microwave procedure), resp.!**

Suited for: Aluminium test 1-02*, Chromate test 1-25, Iron test 1-36, Cobalt test 1-51, Copper test 1-53, Nickel test 1-62, Zinc test 1-95.

* only for microwave decomposition

C. Extraction methods

Pour decomposed solution into a separation funnel 100 mL and rinse decomposition vessel or reaction tube with about 40 mL distilled water (corresponds to the 50 mL sample solution mentioned in the procedures). Measure according to original procedures. **Multiply results by 10 (heating block) or 5 (microwave procedure), resp.!**

Suited for: Cadmium test 1-13.

Note: *For determination of total nitrogen please refer to NanOx N or test 0-83/0-88/0-92.*

Analytical quality control: *NANOCONTROL* multistandard Metals 1 (REF 925 015)

NANOCONTROL multistandard Metals 2 (REF 925 016)

4.3 *NANOCOLOR*® *NanOx* N

for oxidative decomposition of *total* nitrogen

***NanOx N: NanOx* decomposition reagent and *NanOx* compensation reagent**

Principle: Oxidation of all inorganic and organic nitrogen-containing substances to form nitrate. Residues of peroxide which remain after oxidation and oxidised chromium(VI), which interfere with the determination of nitrate, are eliminated by a compensation reagent.

Applications:

Decomposition in a heating block: the decomposition in a heating block at 100–120 °C features a lower oxidation potential than microwave decomposition. For mainly municipal waste waters this method can be used if the matrix is constant over a longer time period. In regular intervals the applicability of the method should be checked against a reference procedure (e.g. microwave decomposition). For nitrogen compounds, which are difficult to decompose, the recovery from industrial waste waters can be incomplete or not at all possible.

Pressurised microwave decomposition: this method features the advantages of easy handling and considerable time-saving.

Refer to test 0-83/0-88/0-92 for accessories, reagents and working procedures.

5.11 Procedures for photometric analyses with *NANOCOLOR*® tests when samples are colored or turbid

These procedures can only be used in connection with the corresponding original instructions in this *NANOCOLOR*® manual.

The photometric analysis of water samples with own color or turbidity always requires determination of a correction value. Colors and turbidities cause increased light absorption (increased extinction), thus leading to wrong results. Determination of correction values requires individual procedures for every test.

For example, it is not possible simply to measure the color of the sample without reagents and then substract this value from the test result. In many cases, the reagents alter the color or turbidity of the sample. All changes of the sample during analysis, such as dilution, addition of chemicals which alter pH or redox state have to be taken into account. Only the main reagent, which forms the measured color complex, is not added.

With the *NANOCOLOR*® photometer, the measurement programme for the correction value is started after the measurement of the (turbid or colored) sample (value A) by pressing key OK. The instrument asks for the cuvette with the correction value (value B) and measures the correction. The corrected measurement result is displayed and stored.

Basic procedure:

Determine measuring result as per original instruction = **A**

Determine correction value as per special instruction = **B**

Analytical result = **A – B**

Exceptions: Methods, where decreasing extinctions are measured against a reagent blank value.

In these cases, analytical result = A + B

The corresponding analytical instructions point out this fact.

It is very important to substract only values with equal dimensions (e.g. mg/L N; mg/L NH_4; mmol/m^3; E).

If, in the same matrix, the correction factor for several samples is so low that it can be neglected, it may be possible to work without correction. However, this conclusion can only be drawn from practical experience and cannot be predicted!

5.11.1 Determination of correction values for *NANOCOLOR*® tube tests

For measurement of the correction value use as a blank value a clean, empty test tube filled with distilled water (exceptions: test 0-64/0-65/0-66).

Test	Test tube for correction (value B)
0-03, 0-04, 0-05, 0-06, 0-08 Ammonium 3–200	Proceed as described in the instructions for test 0-03 / 0-04 / 0-05 / 0-06 / 0-08, but **do not add *NANOFIX* R2**, close, mix.
0-07 AOX 3	Almost all colors and turbidities are destroyed under test conditions and do not interfere. Resistant colors and turbidities cause deviating results which cannot be circumvented.
0-09 Lead 5	The original test contains a correction.
0-14 Cadmium 2	Fill **empty** test tube with 4.0 mL sample, add 0.2 mL R2, close and mix.
0-15 Carbonate hardness 15	Open carbonate hardness test tube, add 4.0 mL sample solution, close, mix and adjust to zero (value B). Open test tube, add R2, close and shake well. Measure after 2 min (analytical result A – B).
0-17 Chlorine/Ozone 2 0-18 Chlorine dioxide 5	Fill **empty** test tube with 4.0 mL sample for each test.
0-19 Chloride 200	Open chloride test tube, add 1.0 mL sample solution and 1.0 mL distilled water, close, mix.
0-21 Chlorid 50	Open chloride test tube, add 4.0 mL sample solution and 1.0 mL distilled water, close, mix.
0-24 Chromate 5	Fill **empty** test tube with 4.0 mL sample, add 0.2 mL R2, close, mix.
0-243 *total* Chromium	Proceed as described in the instructions for test 0-243 up to step b incl. After cooling fill 4.0 mL of the preoxidized sample solution into an **empty** test tube.
0-11, 0-12, 0-22, 0-23, 0-26, 0-27, 0-28, 0-29, 0-30, 0-33 COD 40–60000	Almost all colors and turbidities are destroyed under test conditions and do not interfere. COD resistant colors and turbidities cause deviating results which cannot be circumvented.
0-31 Cyanide 08	Proceed as described in the instructions for test 0-31, but add 0.5 mL distilled water instead of 0.5 mL R3.
0-32 Anionic surfactants 4	Proceed as described in the instructions for test 0-32, but instead of 0.5 mL R2 add 0.5 mL distilled water.
0-34 Cationic surfactants 4	Proceed as described in the instructions for test 0-34, but instead of 0.5 mL R2 add 0.5 mL distilled water.
0-35 DEHA 1	Open DEHA test tube, add 4.0 mL sample, close and mix.
0-37 Iron 3	no correction possible.
0-40 Fluoride 2	no correction possible.
0-41 Formaldehyde 8	Open formaldehyde test tube, add 2.0 mL sample solution, close and mix.
0-43 Hardness 20	Open hardness test tube, add 0.2 mL sample solution, close and mix.
0-45 Potassium 50	Open potassium test tube, add 2.0 mL sample solution, close and mix.
0-46 Formaldehyde 10	Fill **empty** test tube with 2.0 mL distilled water, 2.0 mL sample solution and 1.0 mL R2, close and mix.
0-47 Nonionic surfactants 15	no correction possible.
0-49 Silver 3	Proceed as described in the instructions for test 0-49, but add 0.5 mL DMSO instead of 0.5 mL R3.
0-50 organic Acids 3000	Proceed as described in the instructions for test 0-50, but instead of 2.0 mL R5 add 2.0 mL distilled water.
0-52 Compl. agents 10 Anal. result = A + B	Fill **empty** test tube with 4.0 mL sample and 1.0 mL distilled water, close and mix.
0-54 Copper 7	Fill **empty** test tube with 4.0 mL sample and 0.4 mL distilled water, add 0.2 mL R2, close and mix.
0-56 Molybdenum 40	no correction possible.
0-57 HC 300	The original test contains a correction.

Test	Test tube for correction (value B)
0-58 Manganese 10	Fill **empty** test tube with 4.0 mL sample solution, 0.5 mL distilled water and 0.5 mL R2, close and mix. Add 1 measuring spoon R3, close and shake vigorously.
0-61 Nickel 7	Proceed as described in the instructions for test 0-61, but instead of 1.0 mL R2 add 1.0 mL NaOH 14 %.
0-64, 0-65 Nitrate 8–50	Open nitrate test tube, add 0.5 mL sample and 0.5 mL 2-propanol, close, mix. Blank value for correction: Open nitrate test tube, add 0.5 mL distilled water and 0.5 mL 2-propanol, close, mix.
0-66 Nitrate 250	Open nitrate test tube, add 0.2 mL sample and 0.5 mL 2-propanol, close, mix. Blank value for correction: Open nitrate test tube, add 0.2 mL distilled water and 0.5 mL 2-propanol, close, mix.
0-68 Nitrite 2	Fill **empty** test tube with 4.0 mL sample, add 0.2 mL R2, close, mix.
0-69 Nitrite 4	Open nitrite test tube, add 4.0 mL sample solution, close, mix.
0-70 POC 200	Proceed as described in the instructions for test 0-70, but instead of 1.0 mL R2 add 1.0 mL distilled water.
0-72 pH 6.5–8.2	The original test contains a correction.
0-73 Sulfide 3	Fill **empty** test tube with 0.5 mL sulfuric acid 50 %, add 1 measuring spoon R2 and 4.0 mL sample solution, close and shake gently. Add 200 µL R3, close, mix.
0-74 Phenolic index 5	Proceed as described in the instructions for test 0-74, but **do not add *NANOFIX* R2**, close, mix.
0-55, 0-76, 0-80, 0-81 *ortho*- and *total* Phosphate 1–45	Proceed as described in the instructions for test 0-55 / 0-76 / 0-80 / 0-81 but **instead of R4** add 0.2 mL distilled water, close, mix.
0-79 *ortho*- and *total* Phosphate 50	Proceed as described in the instructions for test 0-79, but **instead of R3** add 1.0 mL sulfuric acid 20 %, close, mix.
0-82 Oxygen 12 8-22, 8-25 BOD_5	The original tests contain a correction.
0-83, 0-88, 0-92 *total* Nitrogen TN_b 22 / 60 / 220	Almost all colors and turbidities are destroyed under test conditions and do not interfere. For samples which are still colored or turbid after decomposition, correction values are determined as described above for test 0-64.
0-84 Residual hardness 1	Open Residual hardness test tube, add 5,0 mL sample solution, close and mix.
0-85 Starch 100	no correction possible.
0-86 Sulfate 200 0-87 Sulfate 1000	The original test contains a correction.
0-89 Sulfite 10	Open sulfite test tube, add 4.0 mL sample and 0.2 mL distilled water, close and mix.
0-90 Sulfite 100 Anal.result = A + B	Fill **empty** test tube with 0.2 mL R2, 4.0 mL sample solution and 1.0 mL distilled water, close, mix.
0-91 Thiocyanate 50	Fill **empty** test tube with 4.0 mL sample.
0-93, 0-94, 0-99 TOC 25–600	The original tests contain a correction.
0-96 Zinc 4	Fill **empty** test tube with 4.0 mL sample, add 0.2 mL R2, close and mix.
0-97 Tin 3	Proceed as described in the instructions for test 0-97, add 1.0 mL ethanol instead of R4.
0-98 Aluminium 07	Proceed as described in the instructions for test 0-98, add 0.5 mL distilled water instead of R3.
8-38 Ethanol 1000	Open ethanol test tube, add 4.0 mL R1 and 0.5 mL sample solution (consider dilution), mix, add 2 drops R3, close and mix.
8-59 Methanol 15	Open methanol test tube, add 3.0 mL R1 and 1.5 mL sample solution (consider dilution), mix, add 2 drops R3, close and mix.
8-71 Peroxide 2	Fill **empty** test tube with 4.0 mL sample.

5.11.2 Determination of correction values for *NANOCOLOR*® standard tests with reagent blank value

For tests of this category, the instructions require distilled water plus reagents as a reagent blank value. Another volumetric flask 25 mL is necessary for the correction value. Distilled water is used as a blank value for the correction value.

For some tests, a special reagent has to be prepared for correction. If reduced sample volumes are used for a test (dilution due to concentrations which are too high), the sample volume for determination of the correction value must be reduced by the same amount.

Test		Preparation for correction (value B)
1-02	Aluminium	20 mL sample; 0.2 mL R1, mix; 1 measuring spoon R2, mix; 2 mL R4, mix; fill to 25 mL with distilled water, mix.
1-05	Ammonium	20 mL sample; 1 mL R1, mix; fill to 25 mL with distilled water, mix.
1-20	Chloride	20 mL sample; 2 mL R1, mix; fill to 25 mL with distilled water, mix.
1-42	Fluoride	no correction possible.
1-44	Hydrazine	20 mL sample; 2 mL R1, mix; fill to 25 mL with distilled water, mix.
1-48₃	Silica (high sensitivity)	20 mL sample; 1 mL sulfuric acid 10 %, mix; 1 mL R2, mix; 1mL R3, mix; fill to 25 mL with silica-free water, mix.
1-51	Cobalt	20 mL sample; 1 mL R1, mix; 1 mL R3, mix; fill to 25 mL with distilled water, mix.
1-63	Nitrate Z	20 mL sample; 1 mL R1, mix; fill to 25 mL with distilled water, mix.
1-65	Nitrate	4.0 mL Nitrate R1, 0.5 mL sample, 0.5 mL 2-propanol, mix. Blank value for correction: 4.0 mL Nitrate R1, 0.5 mL distilled water, 0.5 mL 2-propanol, mix.
1-67	Nitrite	20 mL sample; 2 mL R1, mix; fill to 25 mL with distilled water, mix.
1-75	Phenol	20 mL sample; 1 mL R3, mix; fill to 25 mL with distilled water, mix.
1-77	Phosphate	20 mL sample; 1 mL sulfuric acid 30 %, mix; 1 mL R2, mix; fill to 25 mL with distilled water, mix.
1-78	Phosphate	20 mL sample, **1.5 mL R1**, mix; fill to 25 mL with distilled water, mix.
1-95	Zinc	20 mL sample; 1 mL R1, mix; 1 mL DMSO, mix; 1 mL R3, mix; fill to 25 mL with distilled water, mix.

5.11.3 Determination of correction values for *NANOCOLOR*® standard tests with sample blank value

For the tests of this category, the correction can already be performed during the measurement. In these cases the following preparations are used as blank values instead of the blank values given in the instructions.

For some tests, a special reagent has to be prepared for correction. If reduced sample volumes are used for a test (dilution due to concentrations which are too high), the sample volume for determination of the correction blank value must be reduced as well.

Test		Preparation for correction blank value
1-16	free chlorine	20 mL sample; 1 mL R1, mix; fill to 25 mL with distilled water, mix.
	total chlorine	20 mL sample; 1 mL R1, mix; 5 drops of R3, mix; fill to 25 mL with distilled water, mix.
1-25	Chromate	2,0 mL R2; 20 mL sample, mix; fill to 25 mL with distilled water, mix.
1-30	Cyanide	20 mL sample; 1 spoon R1, dissolve; 2 mL R3, mix; fill to 25 mL with distilled water, mix.
1-36	Iron	20 mL sample; 1 mL R1, mix; 1 spoon R2, mix; 1 mL R3, mix; fill to 25 mL with distilled water, mix.
1-48	Silica	20 mL sample; 1 mL sulfuric acid 10 %, mix; 1 mL R2, mix; 1 mL R3, mix; fill to 25 mL with distilled water, mix.
1-53	Copper	20 mL sample; 2 mL R1, mix; fill to 25 mL with distilled water, mix.
1-60	Manganese	20 mL sample; 1 mL R2, mix; 1 mL R3, mix; fill to 25 mL with distilled water, mix.
1-62	Nickel	20 mL sample; 1 mL R1; 1 mL R2, mix; 1 mL R3, mix; fill to 25 mL with distilled water, mix. Note: The yellow color produced by the addition of R2 must disappear when R3 is added!
1-88	Sulfide	20 mL sample; 1 mL sulfuric acid 50 %, mix; fill to 25 mL with distilled water, mix.