

Photometric determination



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Applications and meter overview

Photometric determination is an important measurement procedure for routine analysis in water , production industry, and in environmental monitoring. But also, for special measurement tasks and quality control in industry, development, research and education.

● yes

✓ recommended

✓ recommended for some applications

– not recommended/not present

	Laboratory photometer				Portable photometer		
	photolab® 7100 VIS	photolab® 7600 UV-VIS	photolab® S6	photolab® S12	pHotoFlex® STD	pHotoFlex® pH	pHotoFlex® Turb
Photometric determinations	●	●	●	●	●	●	●
Electrochemical pH/ORP measurement						●	●
Turbidity measurement as per DIN JSO							●
Reagent-freeReagent-free COD, nitrate, nitrite		●					
Spectrophotometer (adjustable wave lengths)	✓	✓					
Filter photometer			✓	✓			
LED + optical filter					✓	✓	✓
6 wavelengths			✓		✓	✓	✓
12 wavelengths				✓			
IR-LED							✓
Programs for test kits	✓	✓	✓	✓	✓	✓	✓
Round cells 16/28	✓/-	✓/-	✓/-	✓/-	✓/✓	✓/✓	✓/✓
Rectangular cuvettes 10, 20, 50 mm	✓	✓		✓			
AQA support	✓	✓	✓	✓	✓	✓	✓
Barcode support	✓	✓	✓	✓	optional	optional	optional
Sample ident. Number	✓	✓	✓	✓	✓	✓	✓
Special methods NH ₃ , CO ₂	✓	✓				✓	✓
Reagent-free data base correction: Reagent-free (reagent-free reagent-free COD, nitrate, nitrite)		✓					
User-defined programs	✓	✓		✓	✓	✓	✓
Comprehensive programming	✓	✓					
Multi-wavelength measurement/scans	✓	✓					
Color measurement, PC-based	✓	✓					
Coloration	✓	✓	✓	✓	✓	✓	✓
Kinetics	✓	✓		✓			
pH/ORP/Turb					-/-/-	✓/✓/✓	✓/✓/✓
PC software data management + LIMS connection	✓	✓			✓	✓	✓
PC interface USB / Ethernet / RS232	✓/✓/-	✓/✓/-	-/-/✓	-/-/✓	-/-/✓	-/-/✓	-/-/✓
Battery/rechargeable battery	-/-	-/-	-/✓	-/✓	✓/-	✓/optional	✓/optional
Car battery adapter for off-line use	✓	✓					
Field case set/field case	-/✓	-/✓			✓/✓	✓/✓	✓/✓
see page	138	139	141	141	144	145	145

	Thermoreactors		
	CR 2200	CR 3200	CR 4200
Routine analysis	✓	✓	✓
Routine programs for wastewater/electroplating	✓	✓	✓
User-defined programs up to 170°C		✓	✓
Two different digestion programs in parallel			✓
AQA		✓	✓

Systematic and spectral analysis – routine measurement and photometric investigation

Photometric determinations can be divided into two large groups.

The **routine measurement** of measuring parameters in water analysis, also known as systematic analysis, facilitates a simple and quickly readable measurement with minimum effort using commercial test kits and the associated method data in the photometer. Thus, the analyte to be measured is transformed to a measurable colorant with the relevant reagents. The coloration results from the absorption of particular light components (wavelengths) from white light. Measurements are usually taken at the wavelength with the highest absorption.

Such routine measurements are standard tasks in water analysis of wastewater, drinking water or environmental monitoring.

Photometers and optimized test kits for various measurement ranges form a system, which is harmonized. Method data and programs as well as measuring ranges for the respective test kits are not identical in different photometer models due to the optical variations such as light sources.

Spectral analysis is particularly useful for studies of unknown substances, methods development and for optimizing testing systems: In order to, for example, determine the maximum absorption and thus the suitable wavelength for test systems, spectra are taken over a wider wavelength range. Thus, the highest peak and most suitable absorption is detected. In addition there are investigations such as enzyme kinetics or multi-wavelength measurements. A further aspect is color measurement for the product quality analysis and assurance.

What do all of the series offer?

- **Proven quality**
- **Intuitive operation**
- **The highest precision**

Three classes of photometric instruments for different applications:
pHotoFlex® series portable LED photometers (left)
photoLab® S series filter photometers (bottom right)
photoLab® 7000 series spectrophotometers (top right)



Portable and precise: the pHotoFlex[®], photoLab[®] and photoLab[®] 7000 Series

Mobile measurement	Lab Measurement
with the pHotoFlex [®] Series	with photoLab [®] S6/S12 and the photoLab [®] 7000 Series
Measurement in changing locations is the focus. The meters are: <ul style="list-style-type: none"> energy-efficient robust portable precise These requirements are backed up by special optics with a combination of LED and filters. The robustness of the portable pHotoFlex [®] meters is based on the low warm-up and long lifetime of LEDs used. With two cuvette sizes, the largest possible measurement ranges and the use of most common test kits are made possible using the LabStation and LSdata PC software for comfortable data management.	Highest standards are required in the laboratory as basis of research, routine measurements and to ensure effluent compliance. To meet these needs, the instruments offer: <ul style="list-style-type: none"> AQA/IQC precise measurement wide measurement ranges convenience features, such as test and cuvette recognition. The reference beam optics and stable laboratory temperatures enable full pre-settings with higher work comfort. Additional features of the photoLab [®] 7000 Series: <ul style="list-style-type: none"> Testing from 190 - 1100 nm Reagent-free measurement of COD, nitrate and nitrite AQA and user administration Spectra, kinetics and multi-wavelength readings Data transfer via USB, even in large user environments

Photometer applications

	Portable photometers			Filter photometer		Spectrophotometers	
	pHotoFlex®			photoLab®			
	STD	pH	Turb	S6	S12	7100 UV	7600 UV-VIS
Applications / Application fields	Environmental monitoring, water analysis	Environmental monitoring, water analysis, drinks industry, wine industry, process monitoring, areas with different measurement tasks (photometry, pH, turbidity)		Routine measurements in waste and drinking water, field use optional	Routine measurements in waste and drinking water, wide-ranging laboratory testing tasks, field use optional	Spectral and special analyses in industry, teaching and research, and all analyses of routine measurements with standard parameters in waste and drinking water, as well as environmental analysis, on-site use	
Wavelengths	436, 517, 557, 594, 610, 690 nm	436, 517, 557, 594, 610, 690 nm	436, 517, 557, 594, 610, 690 nm, 860 nm (IR)	340, 445, 525, 550, 605, 690 nm	340, 410, 445, 500, 525, 550, 565, 605, 620, 665, 690, 820 nm	320 nm–1100 nm (VIS), fully adjustable	190 nm–1100 nm (UV-VIS), fully adjustable
Optical system	LED with filter	LED with filter	LED with filter	Filter/reference beam		Monochromator/beam-in + AutoCheck	
Special functions	–	pH/ORP	pH/ORP, turbidity	–	Kinetics	Absorption spectra, kinetics, multiple wavelength measurement, environmental parameters, routine and special measurements with AQA support, PC software photoLab® spectral data	
	optional: LabStation with LSdata PC software, rechargeable battery set, LSdata PC software (single package)						
Data sets	100	1000	1000				
Custom methods	50	100	1000	no	50	1000, 20 profiles	
Cuvettes	Round: 16 mm (variable height: 91 – 104 mm), 28 mm			Round 16 mm	Round and rectangular 10, 20, 50 mm		

The photoLab®7000 Spectrophotometers

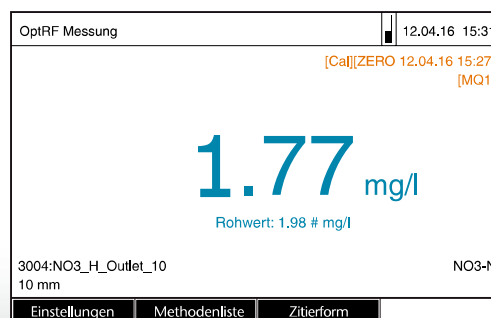
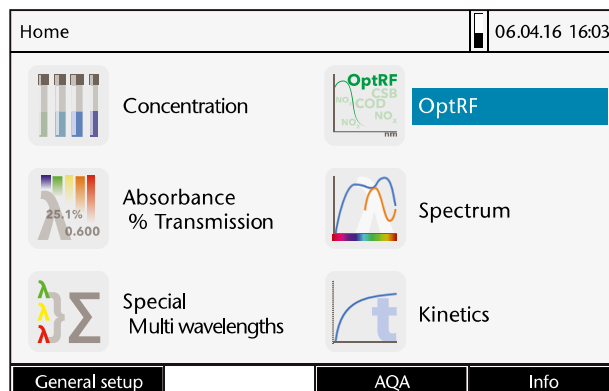
All in one, one for all!

WTW spectrophotometers offer a unique combination in this instruments class of systematic and spectral analysis functions with the revolutionary reagent-free OptRF measurement for COD, nitrate and nitrite. They can be used for a wide variety of applications, from water analysis to the wine industry to science and teaching.

The quality reference beam optics ensures the greatest precision and is supported by comprehensive user management for the highest level of data security.

Thanks to the self-explanatory menu, the user can intuitively and quickly achieve the desired result:

- Bright color screen for a clear view of work processes with color-marked additional information and visual evaluations.
- Direct function call-ups via function keys F1 to F4 for standard functions such as menu-related settings, dilution, unit, etc.
- Search masks for the simplest selection of parameters, methods, etc.
- Reliable and robust tactile keypad
- Filter data for specific measurement datasets
- Input screens for user-defined methods and complex programming
- USB and Ethernet connection for data processing: Update, printing to PDFs and printers, saving and data export with LIMS connection



Systematic analysis - routine measurement of standard parameters

The photoLab® 7000 Series offers proven and innovative functionalities for routine measurements in water analysis as well as standard laboratory tasks.

- Round *and* rectangular cuvettes with barcode recognition for large measurement ranges
- Automatic cuvette recognition with automatic measurement range selection
- More than 250 methods for commercial test kits
- Direct methods such as SAC, UVT, coloring
- Color measurement as per APHA 2120F
- Application packets and methods such as chlorophyll, brewing trade, etc.
- Custom routine methods
- OptRF: Unique optical reagent-free measurement of COD, nitrate and nitrite with photoLab® 7600

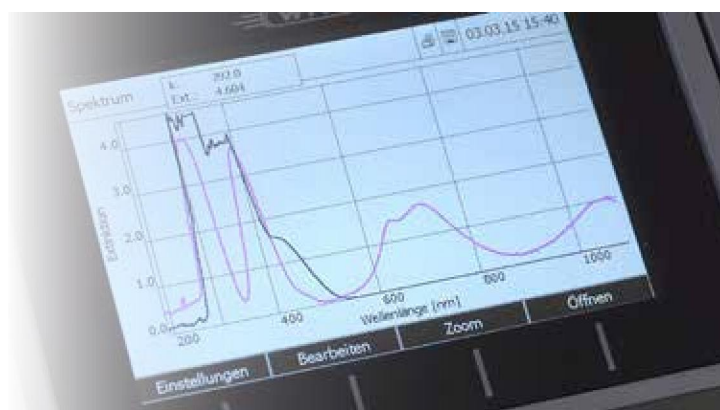
Select method (all)				08/08/07 10:40
4	N2/25	NO ₃ -N	0.5 - 25.0 mg/l	▲
5	N5/25	NO ₂ -N	0.010 - 0.700 mg/l	
6	P6/25	PO ₄ -P	0.05 - 5.00 mg/l	
7	P7/25	PO ₄ -P	0.5 - 25.0 mg/l	
14	14540	COD	10 - 150 mg/l	
15	FB436	DFZ	0.5 - 50.0 m ⁻¹	
17	14554	Ni	0.10 - 6.00 mg/l	
18	14785	Ni	0.10 - 5.00 mg/l	
21	IodFa	IFZ	1.0 - 50.0 IFZ	
23	14541	COD	25 - 1500 mg/l	▼
Last used				

Edit method		03/28/08 12:05
Number		1001
Designation		
Version		1.00
Wavelength		320 nm
Cell		16 mm
Citation form		
Unit		mg/l
Resolution		0.01
Calibration curve		Measure standard solutions
		Method list Delete Next

Spectral analysis - from spectra to kinetics to programming

The photoLab® 7000 Series facilitates comprehensive laboratory analysis from water to research and teaching, even when on the go:

- Optical reagent-free measurement (OptRF) of COD, nitrate and nitrite via spectral measurement with evaluation between 200 and 390 nm,
- Kinetics with maximum or freely adjustable measurement count, time intervals and start delay.
- Spectra with custom definable wavelength range
- Multiple wavelength measurements
- Special tasks/form inputs for comprehensive measurement processes
- 20 profiles and 6 colors can be saved



Analytic quality assurance – for result security

Analytic quality assurance (AQA) has become a must for all branches of industry to ensure and document plausible and correct measurement results.

The photoLab® 7000 Series enables AQA with monitoring of the photometer and measurements. AQA can be switched on and off as desired and offers a monitoring function through:

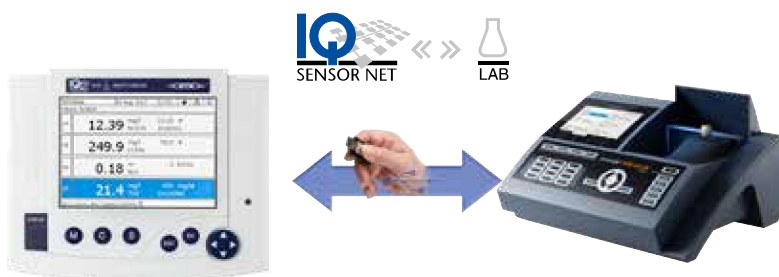
- Administrator, user and guest rights
- Adjustable inspection intervals for Photometer and test kits
- PhotoCheck: Photometer check incl. check for linearity (3 wavelengths at 4 measurement points)
- Selection for gray filter and test standards
- Standards for individual parameters and CombiChecks
- Matrix check with pile-up





AQA2 setup		08/16/07 18:25
General		
Mode	Measurements	
Lock methods	Yes	
Method	6: P6/25	
AQA2	AQA2 inactive	
Interval	50 Measurements	
Target value	0.80 mg/l PO ₄ -P	
Tolerance	0.08 mg/l PO ₄ -P	
Standard ID		
Method		Apply

- Comprehensive test equipment
- MatrixCheck documentation
- User management

IQ LabLink – the connection to the IQ SENSOR NET process monitoring system



IQ-LabLink		  08/21/08 11:51	
Job number:	050	Date:	08/21/08
Sensor type:	VARION+7000IQ	Serial number:	04460001
Sensor name:	04460001		
Photometer:	photoLab 6100 V15	Serial number:	07440001
User:	admin	Date:	08/21/08
Parameter	Value of sensor	Lab value	Status
NH ₄ -N	2.2 mg/l (210 mV)	---	-
NO ₃ -N	8.5 mg/l (1291 mV)	---	-
K	20.9 mg/l (217 mV)	---	-
Job status: In process			
Please select the parameter and start measurement process by pressing <START/ENTER>			
Select Job			

IQ LabLink creates an automatic connection between the WTW IQ SENSOR NET process monitoring system and photometric laboratory measurement.

As all wastewater has a specific material composition (matrix), from time to time a fine adjustment of the online measurement is carried out via a matrix adjustment. The values for the matrix adjustment are determined with a photometer and transferred back to the correct sensor – without any cable clutter!

- Simple selection of the measurement settings
- Clearly listed multiple measurements
- Data output with commentary function




- Comfortable and menu-prompted reconciliation procedure
- Secure and fast data transfer via USB
- Automatic allocation when several sensors are used

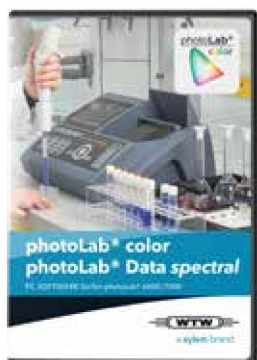
photoLab® color - color measurement instead of color perception

The photometric color measurement stands out in comparison to the visual procedure due to its objective and precise measurement: photoLab® color enables PC-controlled color measurement with the spectrophotometers of the photoLab® 6000 and 7000 Series for the quality control of substances from water to wine or from resin to sugar.

photoLab® color shines with its easy method selection and clearly listed multiple measurements with data output and commentary options. Supported measurements include CIE 15:2004, ADMI, Hazen, Yellowness, Gardner, etc.



-  **PC-controlled**
-  **Conforming to standards**
-  **CSV and PDF export**



photoLab® Data spectral - data management made simple

The PC software module photoLab® Data spectral is for the photometers of the photoLab® 6000/7000 Series photometers. It offers a clear interface for easy data exchange between PCs and photometers as well as the GLP compliant further processing of datasets with LIMS or spreadsheet programs.

Brewery application package for the photoLab® 6000/7000 Series

The package contains MEBAK standard methods for the measurement of the typical parameters in the brewing industry (EBC)

α -acids	Standard methods
Anthocyanins (Harris - Rickett method)	EBC
Bear measurement in beer*	EBC
Beer coloring	EBC
Beer measurement in wort*	EBC
Copper	EBC, cuprethol method
Flavonoids	EBC
Free amino nitrogen (FAN) in darker beers	EBC (with notification)
Free amino nitrogen (FAN) in darker worts	EBC (with notification)
Free amino nitrogen (FAN) in light beer	EBC (with notification)
Free amino nitrogen (FAN) in light worts	EBC (with notification)
Iron	EBC methods with calibration line
Iso- α -acids (only with photoLab® 7600 UV-VIS!)	Multiple wavelength method
Nickel	EBC
Photometric iodine test	Method with adjustment factor
Reduction capacity	
Steam-volatile phenols	Methods with calibration line
Thiobarbituric acid count TBA in beer and wort	
Thiobarbituric acid count TBA in congress wort	
Total carbohydrate	EBC
Total polyphenols	EBC
Vicinal diketones (diacetyl, 2,3-pentanedione)	EBC

photoLab® 7100 VIS Spectrophotometer - Simplifying the routine



photoLab® 7100 VIS

- 320 - 1100 nm
- More than 250 standard methods
- Special methods
- Color measurement

From aquaculture to environmental monitoring

Fast and cost-effective routine analysis with AQA for wastewater, drinking water, environmental monitoring, and monitoring authorities as well as special procedures for environmental parameters such as chlorophyll or industrial fish farming.

From wine to science

Menu based guidance makes complex application procedures in the food and beverage industry, production operations, or service laboratories fast, simple, and clear.

- Preprogrammed multi-step or multiple wavelength methods
- Comprehensive programming options for user applications
- Absorption spectra and kinetics measurements
- Instruction in essentials and modern photometrics in teaching and training.
- Complex color measurement with the PC-based software photoLab® color (see page 137).

photoLab® 7600 UV-VIS Spectrophotometer - with OptRF



photoLab® 7600 UV-VIS

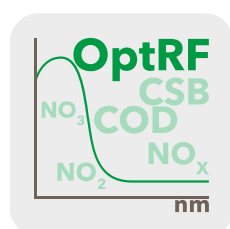
The photoLab® 7600 UV-VIS spectrophotometers combines tried and tested routine functions with pathbreaking spectral analytical functions and OptRF for reagent-free measurement. It is the one system for reference measurements for process systems to special applications in laboratory analysis.

- **190 - 1100 nm**
- **OptRF reagent free methods for COD, NO₃, NO₂**
- **Comprehensive programming options**

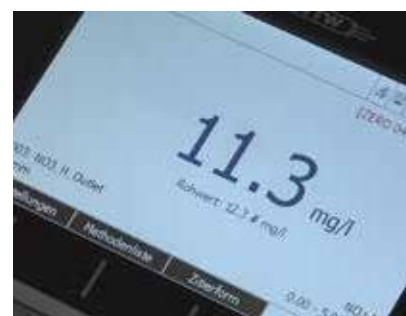
OptRF - optical reagent-free measurement of COD, nitrate and nitrite

OptRF has brought online measurement into the laboratory: COD, nitrate and nitrite can be recorded, calculated, and immediately displayed as a measurement value using a spectral scan in a quartz cuvette. The range of application for OptRF include:

- Communal wastewater treatment plants and, partially, septic tanks
- Many surface waters (COD, NO₃; after pre-tests)
- Cost-free measurement range check for routine analysis
- Quick reference measurement for the matrix adjustment of online sensors



- **Faster than the fastest digestion**
- **Free of cost due to no reagents or chemicals**
- **Environmentally-friendly and harmless to health**



UVT and SAC

These parameters are increasingly important for checking UV disinfection as well as monitoring of the organic load: There are a total of 5 methods with and without turbidity adjustment available.

From training to the sugar industry

There are special methods and comprehensive programming for user-defined applications available for varied and mixed tasks in the range of 190–1100 nm. This supports universities in research and training, mixed applications in the food and beverage production industries, or service laboratories with specialist tasks.

On the go with the photoLab® 7000 Series – mobile applications



photoLab® in the field case

The light and handy photoLab® 7000 series spectrophotometers can be used on-site with a car battery to, for example, monitor and take reference measurements of water operations and for official monitoring.

Alongside a transport case, a 12 V adapter cable for operation with standard trade car batteries is available as an accessory.

photoLab® Technical Data Spectrophotometer

Model	photoLab 7100 VIS	photoLab 7600 UV-VIS
Wavelength range (nm)	320–1100 nm	190–1100 nm
Optical system	Grating monochromator	
Light source	Wolfram halogen	Xenon flashbulb
Spectral bandwidth [nm]	4 nm	
Display	Backlit color 7-inch graphic display	
Wavelength precision (nm)	± 1 nm	
Wavelength reproducibility (nm)	< 0.5nm	
Photometric precision	– 0.003 E for E < 0.600; – 0.5 % of the display for 0.600 < E < 2.000	
Photometric reproducibility	– 0.003 E for E < 0.600; – 0.5 % of the display for 0.600 < E < 2.000	
Photometric dissolution	0.5% of the measurement value or 0.005 E in absorbance 2	
Photometric linearity	< 1% for E ≤ 2.000 in the range from 340 to 900 nm	
Scan speed [nm/s]	approx. 13 nm/s	approx. 16 nm/s
Scattered light	< 0.1% T at 340 and 408 nm	< 0.05% T at 340 and 408 nm
Interfaces	Ethernet, USB B, USB A	
Dimensions (L x W x H in cm)	404 x 197 x 314 mm (width x height x depth)	
Weight [kg]	approx. 4.5 kg	

Order information

Model		Order no.
photoLab® 7100 VIS	Spectrophotometer for spectral and systematic analytics of 320 – 1100 nm	250 203
photoLab® 7600 UV-VIS	Spectrophotometer for spectral and systematic analytics of 190 – 1100 nm	250 204
photoLab® color + Data spectral	PC software for color measurement and for simple data management	902 763
PL6-BREW	Application package for the brewing industry as per MEBAK/EBC	250 214
FC spectral 6/7	Transport case for the photoLab® 6000 and 7000 Series	250 212
ADA 12V	Adapter for 12V (auto-) operation for the photoLab® 6000 and 7000 Series	902 760
Accessories & cables see price list or www.WTW.com		