

Turbidity measurement



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Application areas and meters overview

The turbidity of a sample is a subjective perception and in shows variable effects in contrast to electrochemical or physical parameters. It is based on particles that are dispersed in a solution, of different sizes, differently shaped and movable. Turbidity measurement serves as a quality and indicator parameter in many applications.

● yes

✓ yes

– not recommended/not present

Applications	Turb® 430 IR	Turb® 430 T	Turb® 355 IR
Turbidity in drinking water as per EN ISO 7027	●		●
Turbidity in drinking water as per US EPA 180.1		●	
Official monitoring	●	●	●
Environmental monitoring	●	●	●
Industry, quality control with IR 860 nm	●		●
Industry, quality control with halogen 560 nm		●	
Service laboratories, mixed applications	●	●	●
Field applications and mobile QC	●	●	
Properties			
Standard measurement < 1 NTU	✓	✓	–
AMCO Clear® calibration standards	✓	✓	✓
AQA with documentation/protocol	✓	✓	–
Calibration interval	✓	✓	–
Data management PC software LSdata (on request)	✓	✓	–
LIMS connection via LSdata	✓	✓	–
PC port	✓	✓	–
Battery/battery packs	✓/✓	✓/✓	✓/–
Data memory	✓	✓	–
Software methods update	✓	✓	–
Standalone instrument / LabStation (as laboratory solution, optional)	✓/✓	✓/✓	–/–
Carrying case kits	✓	✓	✓
	Turb® 430 IR	Turb® 430 T	Turb® 355 IR
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Turbidity measurement: A parameter for quality control

In quality monitoring, the measured value "turbidity" is a meaningful indicator parameter. This applies e.g. for drinking water treatment, where the number of particles must be less than 1 NTU as a possible base for bacteria. In beverage production, in the chemical industry, in the production of vaccines or even fuels for engine development, turbidity is a quality control with "in-house" limit value definitions.

Undissolved solids in liquid, as e.g. algae, sludge, microbes or other particles, absorb and scatter light passing through. As the number of particles increases, the turbidity degree also increases noticeably for our eyes. The shape, size and composition of the particles influence the degree of turbidity. The measurement of the scattered light at a 90 ° angle has proven to be superior, especially in the low measuring ranges, and is therefore standard for measuring in drinking water control.



Various standard specifications for drinking water monitoring

There are different types of measuring instruments that differ with respect to the light source: For standard-compliant measurements in accordance with ISO 7027 / DIN EN 27027 (EN ISO 7027), an IR LED (infrared) with a wavelength of 860 nm is required. The Standard Methods for the Examination of Water and Waste water / US EPA require a tungsten broadband light source ("white light").

Infrared or white light depending on the application

For applications without standard specifications, the optimum solution is sought. As the turbidity measurement is often used for quality control, the measurement should be carried out in a previously internally defined measured value window.

- Infrared (IR) light sources minimize or eliminate the influence of coloring in a solution, as at the wavelength of 860 nm virtually no absorption takes place. It is therefore particularly advantageous for colored solutions. The detection sensitivity for small particles is somewhat lower at this wavelength due to the generally lower scattering of small particles.
- White light has a higher sensitivity for small particles, on the other hand an intrinsic coloring of the solution has a reinforced disturbing factor.

Various measuring methods

Especially in the field of industrial quality control, different methods are used: In addition to the nephelometric measurement with 90 ° scattered light for low turbidity values, the transmitted light method at 180 ° is advantageous for medium and higher turbidity, as the scattered light and the shadow effect between the particles increases with increasing turbidity and the decrease of the light intensity provides a more accurate result.

Depending on the manufacturer or industry, the ratio method measures at different angles and calculates the results. There is no single standard for this.



Turbidity measuring cuvette and standard cuvette

AMCO Clear® turbidity standards

- **±1% Production accuracy**
- **High precision and long-term stability**
- **Does not pose a health hazard**
- **Easy to dispose of**

The calibration of turbidity meters is based on the reproduction of differently sized and shaped particles in the real world. The turbidity standards AMCO Clear® for Turb® instruments are polymeric calibration standards with a defined particle composition and are distinguished from formazine by significantly higher result accuracy and stability without drift behavior. The conventional formazine standards with a tolerance of 5-10% are compared with the production accuracy with regard to the particle composition of 1%. They are batch-certified and N.I.S.T. traceable to formazine.

The standards are optimally matched in the particle composition to the respective instrument optics and are particularly well suited for applications in the lowest measuring range such as drinking water.



AMCO Clear turbidity standards

Mobile turbidity meter with laboratory quality

Turb® 430 IR/Turb® 430 T

The Turb® 430 series turbidity meters are equally well suitable for portable and laboratory use due to their accuracy and laboratory comfort. They cover the measuring range of 0.02-1100 NTU / FNU for nephelometric measurements with 90° scattered light.

Turb® 430 IR fulfils the requirements of DIN 27027/ISO 7027, Turb® 430 T those of US EPA 180.1. The turbidity meters are characterised by many extras:

- Intuitive operation with menu navigation
- Automatic measuring range switching
- Simple and high precision calibration
- AQA by means of calibration protocol and calibration interval adjustment
- 1000 data sets can be stored
- Sample identification number (ID)
- Scattered light behaviour as per Pharmacopoeia 9
- Data output
- Optional PC software LSdata for convenient data management (see page 175)

Turb® 430 turbidity meter with AMCO Clear® turbidity standards

- **Highest precision from 0.02 NTU**
- **According to DIN/EN ISO and US EPA**
- **AQA with GLP-complying documentation**



**2 year
guarantee**

IP 67

CE



Portable turbidity measurement with the Turb® 430 Series

- **Mobile Laboratory quality**
- **Safe working on site**
- **GLP-compliant documentation**

For the mobile monitoring of the drinking water quality of wellheads, cisterns and springs or for environmental monitoring and measurement at various production sites, there is the practical carrying case kit with a small "laboratory table", battery pack and the PC software LSData for data management.



The mobile turbidity laboratory - the carrying case kits for Turb® 430 IR/T

Turbidity measurement in the laboratory with the Turb® 430 Series

- **Highest precision**
- **Data memory and sample ID**
- **Documentation via PC software LSdata (see page 175)**
- **Optional LabStation**

The precision optics together with the long-term stable calibration through the AMCO Clear® turbidity standards and GLP-compliant documentation make the Turb® 430 series the ideal partner for service laboratories, health authorities and manufacturing industry, wherever mobile as well as laboratory use is required.

Turb® 430 turbidity meter with LabStation in mineral water industry



Turb® 355 T / Turb® 355 IR

- 0 - 1100 NTU/FNU
- Simple operation
- Quality control > 1 NTU



Turb® 355 IR/T field case set

Small, portable turbidity meters

Battery-powered turbidity meter with Infrared LED (860 nm) for nephelometric measurements in accordance with ISO 7027/DIN EN 27027 (EN ISO 7027) or as white light model with tungsten lamp in accordance with US EPA.

It is handy, light and very easy to use.

The Turb® 355 IR/T is supplied as a kit in a small carrying case, which contains all necessary accessories (calibration standards 0.02 - 10.0 and 1000 NTU, empty cuvettes and batteries). The instrument operates with 4 MICRO (AAA) Alkali manganese batteries.

2 year
guarantee

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Technical specifications: Turbidity meters

	Turb® 430 IR / Turb® 430 T	Turb® 355 IR / 355 T
Measurement principles	Nephelometric (90° scattered light)	Nephelometric (90° scattered light)
Light source	IR LED / Tungsten lamp	IR-LED/Tungsten lamp
Measuring ranges	NTU 0.02 - 1100 / 0 - 1100 FNU 0.02 - 1100	0 - 1100 0 - 1100
Resolution	0.01 for the range 0.00 - 9.99 0.1 for the range 10 - 99.90 1 for the range 100 - 1100	0.01 NTU in the range 1 - 9.99 0.1 NTU in the range 10.0 - 99.9 1 NTU in the range 100 - 1000
Accuracy	0.01 NTU or ±2 % of the measured value	±2 % of the measured value or ±0.1 NTU last decimal point in the range 1 ... 500 NTU ±3% of the measured value in the range 500 ... 1100 NTU
Repeatability	<0.5 % of the measured value or 0.01 NTU/FNU	±1% of the measured value or ±0.05 NTU/FNU
Calibration	Automatic 3 point calibration	Automatic 1...3 point calibration
Response time	Approx. 3 seconds (IR) / approx 7 seconds (T)	14 seconds
Cuvette	28 x 60 mm, 20 ml sample volume	25 x 45 mm, 15 ml sample volume
Interface	RS 232, USB via adapter	
Particular calibration protocol	Yes	—
Functions Measured value memory	1000	—
RS 232	Yes	—
Date/time:	Yes	—
Data evaluation	Yes	—
Battery	optional	—
Operating temperature	0 - +50 °C	0 - +50 °C
Power Supply	4 Mignon (AA) for approx. 3000 measurements	4 MICRO (AAA) Alkaline batteries sufficient for more than 1,500 measurements

Order information: Turbidity meters

Model	Description	Order no.
Turb® 355 IR	Portable meters a carrying case as per ISO 7027 / DIN EN 27027 (EN ISO 7027), with 3 calibration standards 0.02 - 10.0 - 1000 NTU	600311
Turb® 355 T	as Turb® 355 IR, but with tungsten light source as per US EPA 180.1	600312
Turb® 430 IR	Portable turbidity meter for nephelometric measurements (90 °) according to DIN EN 27027, incl. calibration kit 0.02 - 10 - 1000 NTU, suitable for drinking water	600320
Turb® 430 T	as Turb® 430 IR, but with tungsten light source as per US EPA 180.1	600325
Turb® 430 IR/SET	Portable turbidity meter (90 °) with infrared light source as per DIN EN 27027 in a field carrying case with table insert, calibration set 0.02 - 10.0 - 1000 NTU and accessories	600321
Turb® 430 T/SET	as Turb® 430 IR/SET, but with tungsten light source as per US EPA 180.1	600326
For additional products, sets, and accessories, see price list or www.WTW.com		



Multi parameter

pH

ORP

ISE

Dissolved Oxygen

Conductivity

BOD/Respiration

Photometry

Turbidity

Software, Documentation

Software, documentation



Content

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Software and data documentation

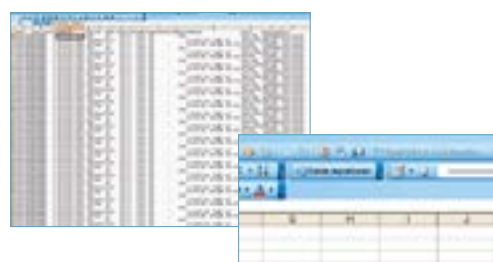
Documentation of measurement data for the storage and, further processing, is an important task to be completed. Tailor-made programs for each product are available:

MultiLab® Importer

For the transfer of measurement data incl. sensor and instrument parameters to Excel®; for MultiLine®, ProfiLine and inoLab® meters

The MultiLab® Importer is a free Excel® add-in for the simple transfer of measurement values

- Automatic recognition of the connected device
- Structured data structure for quick processing
- Clear documentation of the calibration protocol via text fields

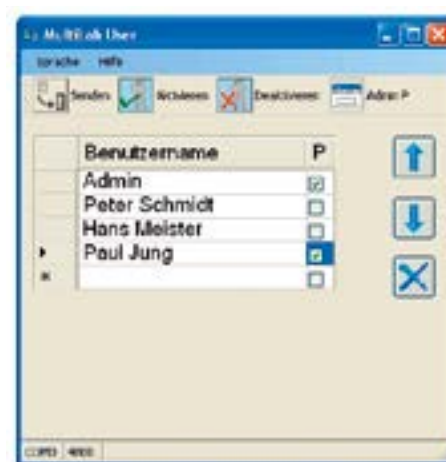


Software screenshots

MultiLab® User

For setting up user administration; for all current MultiLine® or inoLab® Multi IDS meters (Multi 3510 IDS, 3620 IDS, 3630 IDS, inoLab® Multi 9310 IDS, 9620 IDS, 9630 IDS)

- User administration setup as per GLP/GMP guidelines
- Up to 50 users with password possible
- Three access levels with different authorizations
- Password-protected administrator access
- Traceability through the allocation of measurement data/users
- For Multi 3620 IDS, 3630 IDS, inoLab® Multi 9620 IDS and 9630 IDS: Individual digital designation of IDS sensors possible

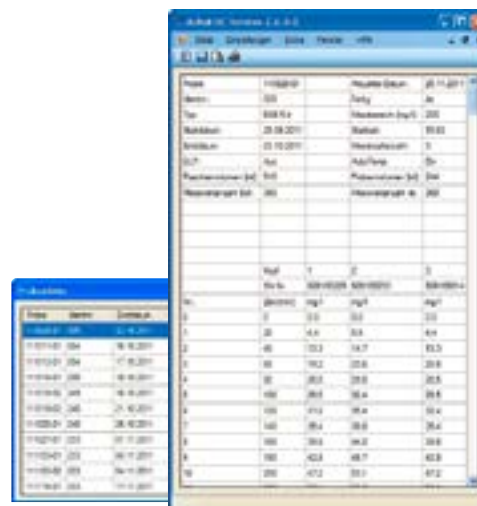


ACHAT OC

For the recording of measurement data; for OxiTop® Controller OC 100 or OC 110 (free download)

The Achat OC is a program compatible with the most recent PC environments for the recording of data from the OxiTop® Control systems. With a redesigned interface, it presents the data clearly and ensures the export in *.csv format.

- Import of all data from the controller
- Export for processing in Excel or CSV format
- Simple data transfer with one mouse click



photoLab® color – color measurement instead of color perception

For PC-controlled color measurement; for photoLab® 7100 VIS and 7600 UV-VIS

photoLab® color offers a clear and intuitive user interface for multiple measurements, method switches, and direct data management and printouts of the measuring results.

- CIE color measurement XYZ, x,y,z, CIE-L* a* b*,
- CIE-L* u* v*
- Hazen (Pt-Co)
- Yellowness index
- ADMI color number
- ASTM
- Gardner
- Sugar color ICUMSA
- Beer color as per EBC and ASBC
- Iodine color number



Software screenshots

photoLab® Data spectral

For simple data management; for the photoLab® 6000/7000 Series

- GLP-compliant data management
- Convenient data transfer from measurement instrument to the PC for processing (e.g. with LIMS, XLS, CSV)
- Export of spectra in specialist software for the comprehensive display and processing of spectra
- Reconciliation of methods, profiles and meter updates in several photometers



LSdata

Simple data management for the photoFlex® and Turb® 430 Series

The LSdata PC software for photoFlex®/Turb® 430 meters offers a clear interface for:

- GLP-compliant data transfer (CSV/Excel format)
- The creation and management of user-defined methods via a clear dialog window
- Automatic calculation of the calibration curve for custom-defined methods, method reconciliation between PC and meter(s)
- Documentation of calibration protocols



Overview meters software/connection cable PC or printer

MI = MultiLab® Importer Mp = MultiLab® pilot AO = ACHAT OCMA = Multi/ACHAT II pDS = photoLab® Data spectral LS = LSdata
b = bidirectional r = remote-controlled u = unidirectional

meter	Software	Connection cable	Type	meter (discontinued)	Software	Connection cable	Type
inoLab® pH 7310	MI	AK USB A-Mini	b	pH 340i	Mp	AK 340/B	b
inoLab® Oxi 7310	MI	AK USB A-Mini	b	Oxi 340i	Mp	AK 340/B	b
inoLab® Cond 7310	MI	AK USB A-Mini	b	Cond 197i, 1970i	Mp	AK 340/B	b
inoLab® pH/ION 7320	MI	AK USB A-Mini	b	Cond 340i	Mp	AK 340/B	b
inoLab® Multi 9310 IDS	MI	AK USB A-Mini	b	pH 197i, 1970i	Mp	AK 340/B	b
inoLab® Multi 9420 IDS, 9620 IDS	MI	AK USB A-Mini	b	pH/Cond 340i	Mp	AK 340/B	b
inoLab® Multi 9430 IDS, 9630 IDS	MI	AK USB A-Mini	b	pH/ION 340i	Mp	AK 340/B	b
pH 3310	MI	AK USB A-Mini	b	pH/Oxi 340i	Mp	AK 340/B	b
Oxi 3310	MI	AK USB A-Mini	b	inoLab® 730	Mp	AK 340/B	b
Cond 3310	MI	AK USB A-Mini	b	inoLab® 735	Mp	AK 340/B	b
pH/Cond 3320	MI	AK USB A-Mini	b	inoLab® Level 2	Mp	AK 340/B	b
Multi 3320	MI	AK USB A-Mini	b	Multi 197i, 1970i	Mp	AK 340/B	b
pH 3310 IDS	MI	AK USB A-Mini	b	Multi 340i	Mp	AK 340/B	b
Oxi 3310 IDS	MI	AK USB A-Mini	b	Multi 350i	Mp	AK 340/B	b
Cond 3310 IDS	MI	AK USB A-Mini	b	Oxi 197i, 1970i	Mp	AK 340/B	b
MultiLine® IDS: Multi 34x0, Multi 3510 IDS, Multi 3620 IDS, Multi 3630 IDS	MI	AK USB A-Mini	b	Oxi 3315	MI	AK USB A-Mini	b
pHotoFlex® Series	LS	AK 540 B, ADA USB	u				
photoLab® S6, S12	MA	AK Laboratory	b				
photoLab® 6000/7000 Series	pDS	Standard cable	b				
Turb® 430 Series	LS	AK 540 B, ADA USB	u				
OxiTop® OC 100/110	AO	AK 540 B	u				

Note:
USB adapter without cable for meters with RS232 interface available; meters-compatible cable required.

Order information: Software

Item	Description	Order No.
KOM pilot	Communications package, consisting of: 1 x MultiLab® pilot and one AK 340/B connection cable	902915
photoLab® color + photoLab® Data spectral	PC software for color measurement and for simple data management	902763
LSdata	PC software for pHotoFlex®/Turb® 430 Series	902762
Multi/ACHAT II	Software for PC in Windows, German and English	902750
KOM Labor	Communications package, consisting of: 1 x Multi/ACHAT II and 1 AK Labor	902754
ADA USB/Ser	USB adapter to serial interface RS 232 (9-pin socket)	902880
For connection cables/further accessories see price list		



Turb[®] 750 Series

LAB TURBIDIMETER WITH IRPC - THE INTELLIGENT VALUE CHECK



a xylem brand

For any application:

Whether it's about pure water or reliable product quality, **turbidity** is often an ideal parameter to use in many applications - and maybe even in fields you have not even thought of before:

- From water* to wine,
- From juice quality to food cleaning processes,
- From fuel to pharmaceutical,
- From industry to aquaculture.

*) To fulfill regulations in drinking water surveillance, two instrument models are available:

Turb® 750 IR according to DIN EN ISO 7027-1

Turb® 750 T according to US EPA 180.1

Water



Waste-water



Wine Beer



Food



Livestock/
Aquaculture



Pharma-
ceutical



Industry



Results you can trust

We make possible what the scattering properties of water allow: A highly precise turbidity measurement between 0–1100 FNU/NTU with automatic switch of measurement range providing the most technically accurate result possible!

The Turb® 750 Series turbidimeters assist you with sophisticated optics, eliminating uncertainty by means of a light trap and our IRPC procedure (see below for definition).

Turbidity	
[IRPC]	[AQA]
0.10 FNU NTU	
[3-P-Std-CAL]	

Turbidity	
[IRPC]	[AQA]
157.0 FNU NTU	
[3-P-Std-CAL]	
15.01.20 16:12	

Measurement with automatic range adaption

A "stable" value must be a correct value

Particles in a solution are in motion and do not stop for the measurement. With the **I**ntelligent **R**eproducibility and **P**lausibility **C**heck (IRPC) procedure, quick multiple measurements with subsequent evaluation and elimination of outliers are performed. The result is "frozen" and shown as a stable reading.

This way, IRPC secures correct and repeatable results.



Calibration with AMCO Clear® standards

Turb® 750 Series is supported by calibration with the proven AMCO Clear® Standards and the use of an optimal measurement window from the vials. A calibration kit for 3-point calibration is supplied with the meter. The following menu-guided calibration functions are available:

- Default 3-point calibration
- Flexible calibration with 2-5 user-defined calibration points
- QuickCAL: 1-point calibration
- Setting of calibration interval
- Storage of calibration protocol

Advantages of AMCO Clear® Standards

AMCO Clear® Standards are made from polymer microspheres and provide a superior level of accuracy and precision:

- Long-term stability without drift (unlike formazine)
- Accurate to 1% lot-to-lot
- Optimized for the respective optics
- Traceable to formazine
- Environmentally friendly and non-toxic
- Easy-to-use

A successful calibration with AMCO Clear® standards is essential to obtain precise and reproducible results on the Turb® 750.

Reliable results with AQA

- Easy-to-clean keypad
- AQA support:
 - Interval
 - Tolerance
 - Protocol
- Direct access to essential functions
- AQA flag in the data sets
- Storage with sample ID
- Calibration interval and calibration protocol
- Data filter for data output
- GLP compliant data management

AQA	
AQA:	On
AQA protocol:	
AQA tolerance:	10%
AQA interval:	90d
Standard:	10.0 FNU/NTU

AQA settings

Store (996 free)	
15.01.2020 11:24:16	
16.80 FNU/NTU	
assign ID:	1
Store (ID: 1)	

Storage with sample ID



Direct access to AQA functions



AMCO Clear®
Kal.Kit 430/750 IR

Data management with Turb[®] Data

Measured values are stored as data sets with the associated calibration protocol, sample ID and AQA informations.

The data output can be done either via printer or hyperterminal by pressing the print key or, more easily, with the supplied PC software Turb® Data:

- GLP compliant data transfer
- Instrument recognition via serial number
- User name input
- Output in CSV format
- Data export to Excel
- Data import into LIMS



Technical Data

Instrument model	Turb® 750 IR	Turb® 750 T
Measuring standards	DIN EN ISO 7027-1	US EPA 180.1
Light source	Infrared LED	White light Tungsten filament lamp
Measuring mode	Nephelometric (90° scattered light)	
Display	Backlit graphics display, 160 x 104 Pixels	
Keypad	Easy-to-clean foil keypad with alphanumeric entry option	
Measuring range	0-1100 FNU/NTU	0-1100 NTU
Units	FNU/NTU	NTU
Resolution	0.01 FNU/NTU in the range 0.00-9.99 FNU/NTU 0.1 FNU/NTU in the range 10-99.99 FNU/NTU 1 FNU/NTU in the range 100-1100 FNU/NTU	
Accuracy	0.01 FNU/NTU or $\pm 2\%$ of reading	0.01 NTU or $\pm 2\%$ of reading, $\pm 3\%$ in the range 500-1100 NTU
Repeatability	< 0.5% of reading	< 1% of reading
Reading mode	Measurement with Intelligent Reproducibility and Plausibility Check (IRPC) procedure, rapid settlement samples supported by fast response time and IRPC.	
Response time	4 sec	7 sec
Calibration - options	Default 3 points standard calibration, flexible calibration with 2-5 user defined calibration points, QUICKCal	
Calibration protocol and interval setting	yes/yes	
AQS-Support	Calibration protocol, AQA flag, cal flag	
Data storage	2500 data sets with cal protocol, AQA flag	
Sample Identification	Alphanumeric entry via keypad	
Firmware update	via USB	
Interface	RS 232, USB, printer via PC or RS232	
Storage condition instrument	-25...+65 °C (13...149 °F)	
Operating temperature range	+5...+55 °C (41...131 °F) +5...+40 °C (41...104 °F) with power plug connected	
GLP-compliant PC software	Turb® Data	
Dimensions (H x W x D)	ca. 290 x 190 x 80 mm (11.42 x 7.48 x 3.15 inches)	
Weight	1.1 kg	
Calibration standards	Cal.Kit for 3-P standard calibration: long-term stable polymer AMCO® Clear standards, 0.02 - 10.0 - 1000 FNU/NTU	
Vials , sample volume	28 mm diameter vials, min. volume 15 ml, borosilicate glass, phenolic resin cap, PTFE-coated rubber seal. No silicon oil required to cover scratches for measurement procedure!	
Sample conditions	Sample temperature < 70 °C (158 °F)	
Power supply	Wide range power supply with plugs for Euro, US, UK and Australia	
Certificates	CE	
Delivery scope	Lab turbidimeter Turb® 750 IR/T, four 1.5 V AA type batteries, wide range power supply, cable USB-A to USB-B mini, six empty 28 mm vials, cap labels for orientation marking, Cal.Kit Turb® 430/750 IR or T, cloth, quick guide, compact operation manual, CD-ROM with extended manual, CD-ROM with Turb® Data PC software, inspection protocol	

Ordering Information

Model	Description	Order No.
Lab turbidimeters		
Turb 750 IR	Turb® 750 IR lab turbidimeter with infra red LED according to DIN EN ISO 7027-1, single instrument with calibration standards set (0.02 - 10.0 - 1000 FNU/NTU), universal power supply 90-250 VAC, six empty vials, PC software Turb® Data	600120
Turb 750 T	Turb® 750 T lab turbidimeter with Tungsten white light according to US EPA 180.1, single instrument with calibration standards set (0.02-10.0-1000 NTU), universal power supply 90-250 VAC, six empty vials, PC software Turb® Data	600130
Turbidity calibration standards		
Kal.Kit Turb® 430/750 IR	Calibration standards set for Turb® 430 IR, Turb® 750 IR and photoFlex® Turb:	600560
	0.02 - 10.0 - 1000 FNU/NTU	
Kal.Kit Turb® 430/750 T	Calibration standards set for Turb® 430 T and Turb® 750: 0.02 - 10.0 - 1000 NTU	600561

Xylem |'zīləm|

- 1) The tissue in plants that brings water upward from the roots;
- 2) A leading global water technology company.

We're a global team unified in a common purpose: creating advanced technology solutions to the world's water challenges. Developing new technologies that will improve the way water is used, conserved, and re-used in the future is central to our work. Our products and services move, treat, analyze, monitor and return water to the environment, in public utility, industrial, residential and commercial building services settings. Xylem also provides a leading portfolio of smart metering, network technologies and advanced analytics solutions for water, electric and gas utilities. In more than 150 countries, we have strong, long-standing relationships with customers who know us for our powerful combination of leading product brands and applications expertise with a strong focus on developing comprehensive, sustainable solutions.

For more information on how Xylem can help you, go to **www.xylem.com**

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