Quality Control Using Turbidity Measurements

Turbidity measurements are of extreme importance in quality monitoring in water, wastewater, beverage production, electroplating and petrochemical applications.

Light passing through liquid that contains undissolved solids, such as algae, mud, microbes and other insoluble particles, is both absorbed and scattered. Turbidity increases with the amount of undissolved solids present in the sample; the shape, size and composition of the particles also influence the degree of turbidity. In the past, turbidity has been determined by simply measuring light passing through the sample. However, measuring the **scattered light at an angle of 90°** has proven to be a more accurate method particularly at lower measuring ranges. Instruments that use this method are also referred to as **nephelometers.**

Turbidity Measurements

- High precision standards*)
- AQA functions
- DIN/ISO + US EPA

*) The supplied polymere standards (AMCO Clear®) are retraceable to formazine standards and rated to be a primary standard according to US EPA. Due to production accuracy, and stability in solution the calibration and the resulting measured values are more precise.

Turbidity instruments or nephelometers differ in light source. To meet ISO 7027/ DIN EN 27027 (EN ISO 7027) standard a measurement at the wavelength of 860 nm is required. The *Standard Methods for the Examination of Water and Wastewater* / US EPA require a white light tungsten lamp.

Which light source – infrared (IR) or white light (tungsten)?

An infrared light source minimizes or even eliminates the influence of coloration in a solution, because there is almost never an absorption at a wavelength of 860 nm. The detection sensitivity for small particles, on the other hand, is somewhat lower at this wavelength because of the generally lower light scattering of small particles.

White light has a higher sensitivity for small particles, however, the inherent coloration of the solution has a stronger disturbing effect in this case.
The IR measurement is required by DIN ISO, the white light measuring by US EPA.

Nephelometric or transmittance measuring?

The nephelometric measurement at 90° scattered light is advantageous for lower turbidity, whereas the transmission measurement at 180° is beneficial for medium to high turbidity values: With increasing turbidity, restray and scattering effects between particles are growing bigger. The reduction of light intensity in this case leads to a more accurate result than a 90° nephelometric measurement. Therefore, lab meters for high values are equipped with several measuring options: Ratio modes calculate the final result from different measured angles. For ratiometric measurements, there is no specific standard method to be followed; rather, procedures are established by the application or industry.

Typical turbidity values for various liquids	
Liquid	**NTU**
Deionized water	0.02
Drinking water	0.02 ... 0.5
Spring water	0.05 ... 10
Wastewater (untreated)	70 ... 2000
White water (paper industry)	60 ... 800

Please note:

As floating and moving particles are measured in turbidity, slight measurement deviations are possible. In order to achieve results that are as representative as possible, attention should be paid to the following:
- samples should be measured immediately, as particles otherwise settle.
- constant lamp operating temperature.
- condensation on samples should be avoided.
- the position of the standards should be marked to exclude the influence of glass inhomogenities.

The Right Instrument for the Right Use

4 models to choose from:
2 portable models, each with either IR or tungsten light source, and 2 laboratory meters with IR or Tungsten light source:

Application areas for turbidity measuring

	Turb® 355 T/IR	Turb® 430 T/IR	Turb® 550/Turb® 550 IR	Turb® 555/Turb® 555
Applications	Portable use for wastewater, surface water and ground water applications	Portable use for all water testing applications incl. drinking water, wine industry, process control Laboratory use: optional for all applications up to 1100 NTU/ FNU with LabStation	Meter for routine and precise measurements	Meter for routine and precise measurements including QC of complex samples and high turbidity values.
Light source	Tungsten lamp/IR LED	Tungsten lamp/IR LED	Tungsten lamp/IR LED	Tungsten lamp/IR LED
Measuring range	0-1100 NTU/FNU	0-1100 NTU/FNU	0-1000 NTU/FNU	0-10000 NTU/FNU/FAU
Calibration	Automatic 1-3 point	Automatic 3 point	Automatic 1-3 point	Automatic 1-5 point
Special features	Portable field meter	Portable field meter Calibration interval Calibration documentation Storage for measure values Optional: LabStation, LSdata	AQA Flow-through measurement (unpressurized)	AQA complete with password protection, ratio method for the reduction of interferences; transmission, flow-through measurement (unpressurized/ up to 4 bar)

Lab Turbidity Meters

Turb® 550 / Turb® 550 IR

- Measuring range 0.01 ... 1 000 NTU with autoranging
- Automatic 1-3 point calibration
- Flow-through measurement

The professional turbidity meter – Up to 1 000 NTU

Laboratory turbidity meters for nephelometric measurements with automatic 1-3-point calibration and calibration interval monitoring. Measuring range selection from 0.01 ... 1 000 NTU is carried out automatically, and for comparative measurements the current and previous values can be shown on the 2-line display.

Standard equipment includes instrument with built-in short operating instructions, 3 cuvettes and 3 standards: 0.02 – 10.0 – 1 000 NTU, AMCO Clear® standards with approval for drinking water as primary standards according to US EPA, and according to EN ISO 7027.

An unpressurized flow-through adapter is available for continuous measurements.

Turb® 555 / Turb® 555 IR

- Measuring range 0.0001 to 10 000 NTU with AutoRange function
- Automatic 1 ... 5 point calibration
- Values displayed in
  – NTU
  – EBC
  – FNU, FAU (Turb® 555 IR)
  – Nephelos (Turb® 550)
- Flow-through measurement

The ADVANCED professional meter – measuring range up to 10 000 NTU

High-precision laboratory turbidity meter with a wide measuring range of 0.0001 to 10 000 NTU (automatic measuring range switching) for all turbidity measuring applications from ultrapure and drinking water measurements, through quality assurance in soft drinks and wastewater treatment. The measuring system with its 4 detectors allows not only nephelometric (90° scatter) measurements and transmittance measurements, but also ratio measurements in which the influences of stray light and sample color are reduced. Comprehensive AQA functions such as monitoring the calibration interval or password protection for calibration and setup access fulfill quality assurance requirements for measured values, and are all also included in the documentation of the measurements.

Continuous flow-through measurements are possible up to a pressure of 4 bar with FLOW-THRU-TURB vessel.

Flow-through vessel Flow-Turb

Come complete with 4 AMCO Clear® standards for calibration up to 4000 NTU. For applications up to 10 000 NTU a further standard is available. Due to the precise manufacturing accuracy and long-time stability, the AMCO Clear® standards are preferred compared to Formazin.

Technical Data

	Turb® 550	Turb® 550 IR	Turb® 555	Turb® 555 IR
Measuring principles	Nephelometric	Nephelometric	Nephelometric ratio method transmission	Nephelometric ratio method transmission
Light source	Tungsten lamp	IR-LED	Tungsten lamp	IR-LED
Measuring range **NTU**	0 ... 1000	0 ... 1000	0 ... 10000	0 ... 10000
FNU	–	0 ... 1000	–	0 ... 10000
EBC	–	–	0 ... 2450	0 ... 2450
Nephelos	–	–	0 ... 67000	–
FAU	–	–	–	0 ... 10000
Resolution	0.01 NTU from 0.00 ... 9.99 0.1 NTU from 10.0 ... 99.9 1 NTU from 100 ... 1000		0.0001 NTU from 0.0001 ... 9.9999 NTU 0.001 NTU from 10.000 ... 99.999 NTU 0.01 NTU from 100.00 ... 999.99 NTU 0.1 NTU from 1000.0 ... 9999.9 NTU	
Accuracy	±2% of value or ±0.01 NTU		0 ... 1000 NTU: ±2% of value or ±0.01 NTU 1000 ... 4000 NTU: ±5% of value 4000 ... 10000 NTU: ±10% of value	
Reproducibility	±1% of value or ±0.01 NTU			
Calibration	Automatic 1...3 point calibration		Automatic 1...5 point calibration	
Response time	< 3 seconds		< 6 seconds	
Cuvettes	28 x 70 mm (1.1 x 2.76 in) round cuvette, 25 ml sample volume			
AQA functions	Calibration interval monitoring Calibration protocol		Calbration interval monitoring Calibration protocol Password-protected access to calibration and configuration time-controlled data transmission	
Operating temperature	+10 ... +40 °C (50 ... 104 °F)		0 ... +50 °C (32 ... 122 °F)	
Power supply	Plug-in power supply 100 - 240 VAC ±10% / 47 - 63 Hz			

Ordering Information

Model		Order No.
Turb® 550	Laboratory turbidity meter with universal power supply 90 ... 250 V, 3 calibration standards 0.02 – 10.0 – 1000 NTU, 2 empty cuvettes	600 100
Turb® 550 IR	Laboratory turbidity meter for measurements according to DIN EN 27 027, ISO 7027 (EN ISO 7027) universal power supply 90 ... 250 V, 3 calibration standards 0.02 – 10.0 – 1000 NTU, 2 empty cuvettes	600 110
Turb® 555	High-end laboratory turbidity meter according to US EPA with universal power supply 90 ... 250 V, 4 calibration standards 0.02 – 10.0 – 100 – 1750 NTU, 3 empty cuvettes	600 200
Turb® 555 IR	High-end laboratory turbidity meter according to DIN/ISO (EN ISO 7027) with universal power supply 90 ... 250 V, 4 calibration standards 0.02 – 10.0 – 100 – 1750 NTU, 3 empty cuvettes	600 210

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For flow-through vessels, calibration standards and other accessories, see WTW Product Details.

Portable Turbidity Meters

Turb® 430 IR / Turb® 430 T

- Scattered light characteristics according to Pharmacopeia 5.0
- Multifunctional LabStation
- GLP/AQA conform documentation

Lab accuracy & comfort in portable field instrument

With the turbidimeters **Turb® 430 T** and **Turb® 430 IR**, the user has the choice to perform nephelometric measurements at 90° scattered light, according to the application and standard required.

The **Turb® 430 IR** meets the DIN 27027/ISO7027 requirements, the **Turb® 430 T** those of US EPA 180.1. The measuring range is from 0 to 1100 NTU/FNU and is identified automatically. Accurate measurements in the lower range, e.g. in drinking water, are easily achieved.

A turbidity measuring lab for in the field – the Turb® 430IR/T sets

All measurements and menu driven 3-point calibration along with the easy functions for accurate and precise measurements require minimal training. The calibration is performed via an AMCO Clear® standards set (0.02-10-1000 NTU). Up to 1000 data sets with ID numbers can be stored and output using the LabStation and powerful LSdata software. ***(see page 108)***.

The quality of the measurement results is supported by adjustable calibration intervals with documentation.

The Turb® 430 is not only a field measuring instrument (especially with the practical field case), but also a "small lab instrument" for applications up to 1100 NTU/FNU and with optimum data management.
Optional: single meter, field case with LSdata, accessories ***(see WTW Product Details)***.

Turb® 355 T / Turb® 355 IR

- 0 – 1100 NTU/FNU
- Easy operation
- Convenient

Small portable turbidity meter for control purposes
Battery-operated portable turbidity meter with Tungsten lamp according to US EPA or infrared LED (860 nm) for nephelometric measurements according to ISO 7027/DIN/EN 27 027 (EN ISO 7027): Handy, lightweight and easy-to-operate.

The Turb® 355 T / IR comes in a handy carrying case. All necessary accessories (calibration standards 0,02 – 10,0 and 1000 NTU, empty cuvettes and batteries) are included. The instrument is powered by 4 AAA batteries.

Technical Data

	Turb® 430 IR / Turb® 430 T	Turb® 355 T / 355 IR
Measuring principles	Nephelometric (90° scatter)	Nephelometric (90° scatter)
Light source	IR-LED/Tungsten lamp	Tungsten lamp/IR-LED
Measuring range NTU FNU	0 … 1100 / 0-1100 0 … 1100	0 … 1100 0 … 1100
Resolution	0.01 from 0.00 … 9.99 0.1 from 10 … 99.90 1 from 100 … 1100	0.01NTU from 1 … 9.99 0.1 NTU from 10.0 … 99.9 1 NTU from 100 … 1000
Accuracy	0.01 NTU or ±2 % of the measured value	±2 % of the measured value or ±0.1 NTU last decimal place in range 1 … 500 NTU ±3% of the measured value in range 500 … 1100 NTU
Reproducibility	<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
Cuvettes	28x60 mm (1.10x2.36 in.), 20 ml sample volume	25x45 mm (0.98x1.77 in), 15 ml sample volume
Interface	RS 232, USB via adapter	
Special functions Calibration protocol Storage of measured value RS 232 Date/Time Data evaluation Rechargeable battery	Yes 1000 Yes Yes Yes Optional	— — — — — —
Operating temp.	0 … +50 °C (32 … 122 °F)	0 … +50 °C (32 … 122 °F)
Power supply	4 x AA batteries for approx 3,000 measurements	4 micro (AAA) alkaline manganese batteries suitable for more than 1,500 measurements

Ordering Information

Model		Order No.
Turb® 355 IR	Portable turbidity meter according to ISO 7027 / DIN EN 27 027 (EN ISO 7027) in professional case with 4 micro (AAA) alkaline manganese batteries, 3 calibration standards 0.02 – 10.0 – 1000 NTU and 2 empty cuvettes	600 311
Turb® 355 T	same as Turb® 355 IR, but with tungsten lamp according to US EPA	600 312
Turb® 430 IR	Portable turbidity measuring instrument (90°) according to DIN EN 27027, includes calibration kit (0.02 - 10 - 1000), 2 empty cuvettes, cleaning tissues, batteries (4 x AA), suited for drinking water. Optional LabStation or rechargeable battery pack, set, LSdata (see WTW Product Details)	600 320
Turb® 430 T	Portable turbidimeter (90°, tungsten) according to US EPA 180.1, includes calibration standard kit (0.02-10-1000 NTU) and accessories: 2 empty cuvettes (28 mm), cleaning tissues, batteries (4 x AA); suitable for drinking water. Optional LabStation or rechargeable battery pack, set, LSdata (see WTW Product Details)	600 325

Turb® 430 IR / Turb® 430 T:
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Turb® 355 T / Turb® 355 IR:
IP 67 CE 2 Year Warranty