

# Turbidity Sensor

(Order Code TRB-BTA)



Turbidity is a measure of water's lack of clarity and is an important indicator of water quality. Water with high turbidity is cloudy, while water with low turbidity is clear. The cloudiness is produced by light reflecting off particles in the water; therefore, the more particles in the water, the higher the turbidity. High turbidity can be detrimental to water quality as more sunlight is absorbed, causing an increase in water temperature. According to the USGS, the turbidity of surface water is usually between 0 and 50 NTU. Turbidity is often higher than this, however, especially after heavy rain when water levels are high.

## Inventory of Items Included with the Turbidity Sensor

Check to be sure that each of these items is included in your Turbidity Sensor package:

- Turbidity Sensor
- Turbidity Accessories Kit (includes one empty cuvette and one cuvette containing 100 NTU StablCal<sup>®</sup> Formazin Standard)
- Material Safety Data Sheet for StablCal Formazin Standard

## Collecting Data with the Turbidity Sensor

This sensor can be used with the following interfaces to collect data:

- Vernier LabQuest<sup>®</sup> as a standalone device or with a computer
- Vernier LabQuest<sup>®</sup> Mini with a computer
- Vernier LabPro<sup>®</sup> with a computer, TI graphing calculator, or Palm<sup>®</sup> handheld
- Vernier Go!<sup>®</sup>Link
- Vernier EasyLink<sup>®</sup>
- Vernier SensorDAQ<sup>®</sup>
- CBL 2<sup>™</sup>

Here is the general procedure to follow when using the Turbidity Sensor:

1. Connect the Turbidity Sensor to the interface.
2. Start the data-collection software<sup>1</sup>.
3. The software will identify the Turbidity Sensor. Proceed to Step 4 to calibrate the Turbidity Sensor
4. There are two options for calibration.
  - A new calibration can be performed each time the Turbidity Sensor is used as described below.
  - A new calibration can be performed as described below and the slope and intercept of the calibration written down. When the sensor is used, the slope and intercept values can be entered manually rather than performing a new

calibration. If the same cuvettes are always used, these calibration values should be good for several months. Periodic checks should be made to insure the calibration is still valid.

## Calibrating the Turbidity Sensor

1. If your sample water is very clear, you might want to let the Turbidity Sensor warm up for about five minutes to assure a stable voltage.
2. Enter the calibration routine for your data-collection program.
3. **First Calibration Point:** Obtain the cuvette containing the Turbidity Standard (100 NTU) and gently invert it four times to mix in any particles that may have settled to the bottom. **Important:** Do not shake the standard. Shaking will introduce tiny air bubbles that will affect turbidity readings.
4. Wipe the outside of the cuvette with a soft, lint-free cloth or tissue.
5. Holding the standard by the lid, place it in the Turbidity Sensor. Align the mark on the cuvette with the mark on the Turbidity Sensor. **Important:** These marks must be aligned whenever a reading is taken.
6. Close the lid.
7. Enter **100** as the value in NTU.
8. Remove the standard.
9. **Second Calibration point:** Prepare a *blank* by rinsing the empty cuvette with distilled water, then filling it to the top of the line with distilled water. **Important:** The bottom of the meniscus should be at the top of the line for every measurement throughout this test. This volume level is critical to obtain correct turbidity values.
10. Screw the lid on the cuvette. Wipe the outside with a soft, lint-free cloth or tissue.
11. Holding the cuvette by the lid, place it into the slot of the Turbidity Sensor. Make sure that the marks are aligned. Close the lid.
12. Enter **0** as the value in NTU. You are now ready to collect turbidity data.

## Data-Collection Software

This sensor can be used with an interface and the following data-collection software.

**Logger Pro 3** This computer program is used with LabQuest, LabQuest Mini, LabPro, or Go!Link.

**Logger Pro 2** This computer program is used with ULI or Serial Box Interface.

**Logger Lite** This computer program is used with LabQuest, LabQuest Mini, LabPro, or Go!Link.

**LabQuest App** This program is used when LabQuest is used as a standalone device.

**EasyData App** This calculator application for the TI-83 Plus and TI-84 Plus can be used with CBL 2, LabPro, and Vernier EasyLink. We recommend version 2.0 or newer, which can be downloaded from the Vernier web site, [www.vernier.com/easy/easydata.html](http://www.vernier.com/easy/easydata.html), and then transferred to the calculator. See the Vernier web site, [www.vernier.com/calc/software/index.html](http://www.vernier.com/calc/software/index.html) for more information on the App and Program Transfer Guidebook.

<sup>1</sup> If you are using Logger Pro 2 with either a ULI or SBI, the sensor will not auto-ID. Open an experiment file for the Turbidity Sensor in the Probes & Sensors folder.

**DataMate program** Use DataMate with LabPro or CBL 2 and TI-73, TI-83, TI-84, TI-86, TI-89, and Voyage 200 calculators. See the LabPro and CBL 2 Guidebooks for instructions on transferring DataMate to the calculator.

**Data Pro** This program is used with LabPro and a Palm handheld.

**LabVIEW** National Instruments LabVIEW™ software is a graphical programming language sold by National Instruments. It is used with SensorDAQ and can be used with a number of other Vernier interfaces. See [www.vernier.com/labview](http://www.vernier.com/labview) for more information.

## Collecting Data

1. Gently invert the sample water to mix in any particles that may have settled to the bottom. **Important:** Do not shake the sample. Shaking will introduce tiny air bubbles that will affect turbidity.
2. Empty the distilled water from the cuvette and rinse it with sample water. Fill the cuvette to the top of the line with sample water.
3. Screw the lid on the cuvette. Wipe the outside with a soft, lint-free cloth or tissue.
4. Hold the cuvette by the lid and place it into the Turbidity Sensor. Make sure the marks are aligned. Close the lid.
5. Monitor the turbidity value. **Note:** Particles in the water will settle over time and show a slow downward drift in turbidity readings; therefore, take your readings soon after placing the cuvette in the sensor.

## Turbidity Sensor Specifications

Range:	0 to 200 NTU
Resolution:	
13-bit (SensorDAQ):	0.13 NTU
12-bit (LabQuest, LabQuest Mini, LabPro, ULL, or Serial Box Interface):	0.25 NTU
10-bit (CBL 2):	1 NTU
Accuracy:	±2 NTU for readings under 25 NTU ±5% of readings above 25 NTU
LED wavelength:	890 nm
Standard:	StablCal Formazin Standard 100 NTU

**NOTE:** This product is to be used for educational purposes only. It is not appropriate for industrial, medical, research, or commercial applications.

## How the Turbidity Sensor Works

Infrared light is directed at a cuvette containing the sample water. This light is scattered in all directions off the particles in the water. A detector, consisting of a photodiode, is placed at a 90° angle to the light source. The amount of light being scattered directly into the detector is measured in volts and translated into turbidity units. This style of turbidity sensor is called a nephelometer. A standard is used to calibrate the

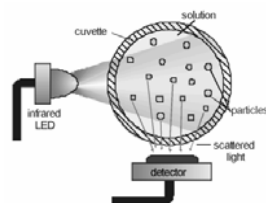


Figure 2: Top View of Turbidity Sensor's Internal Mechanism

Turbidity Sensor in units of NTU, Nephelometric Turbidity Units. Other units such as JTU (Jackson Turbidity Units), and FTU (Formazin Turbidity Units), have values similar to NTU, but are not exactly the same.

This sensor is equipped with circuitry that supports auto-ID. When used with LabQuest, LabQuest Mini, LabPro, Go! Link, SensorDAQ, EasyLink, or CBL 2, the data-collection software identifies the sensor and uses pre-defined parameters to configure an experiment appropriate to the recognized sensor.

## Storage and Maintenance of the Turbidity Sensor

When you have finished using the Turbidity Sensor, simply rinse the sample cuvette with distilled water. It is important to take good care of your cuvette and the Turbidity Standard. Their integrity is essential for accurate turbidity measurements. If they become scratched or broken, a Turbidity Accessories Kit (which includes an empty cuvette and a cuvette with 100 NTU Standard) can be ordered from Vernier (order code TRB-ACC). Hach Company, 1-800-227-4224 [www.hach.com](http://www.hach.com), sells a package of 6 empty cuvettes, order code 24347-06.

## Warranty

Vernier warrants this product to be free from defects in materials and workmanship for a period of five years from the date of shipment to the customer. This warranty does not cover damage to the product caused by abuse or improper use.



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Rev 2/17/10

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