Standard Operating Procedure (SOP) 3.1.5.4

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Turbidity using a Nephelometer ("Turbidimeter")

Nephelometers are electronic turbidity meters that yield results in Nephelometric Turbidity Units (NTUs). NTUs are the standard units for measuring turbidity. Make sure that the turbidity meter that you are using gives results in NTUs. Most small handheld electronic meters that measure turbidity are not nephelometers and are often called "turbidimeters". Each meter is designed with different features and operating functions. Carefully read and follow the manufacturer's instructions when performing turbidity measurements. However, all turbidity measurements should be made by following the general instructions below.

1. Quality Control and Calibration: Always follow the manufacturer's instructions regarding calibration. Some units must be calibrated on the day of the test, while others require less frequent calibrations. For those instruments that do not require daily calibration, make sure to standardize by measuring one or two known standards within (or bracketing) the expected range of the sample prior to making field measurements. If these two standards do not yield accurate measurements then calibrate the unit before actually measuring any water samples. Measure a distilled water field blank (<0.1 NTU) while performing field measurements. After making field measurements then measure one or two standards to determine if the instrument has drifted in its accuracy during the sampling period. Always record the results of any field blanks, standardization, and calibration procedures for future QA/QC reference.

2. If possible, measure turbidity immediately after collecting the sample. If measuring a sample that has not been collected immediately, make sure to mix the sample by gently inverting a few times. Do not agitate aggressively as this will result in air bubbles. If air bubbles do result from mixing make sure that they dissipate before making the measurement. Similarly, always make sure standards are well mixed and free of gas bubbles before use in the meter.

3. The glass tubes must not be scratched or marked in any way. Always make sure that the tubes are dry and clean before placing them in the meter. Clean the surface of the tubes with a clean, soft, and non-abrasive cloth. Make sure there are no smudges or other material on the tubes before taking a reading. If possible, wipe a thin layer of optical oil on the tubes before inserting in the instrument. Use the non-abrasive cloth for this purpose. Do not handle the tubes with bare hands after they are

cleaned with the non-abrasive cloth. Always orient the tubes in the meter in the same way for each measurement. The tubes and meters usually each have a mark that must be lined up before taking the reading.

4. Placing the tube into the Nephelometer: Again, never handle the tube by the glass; instead, handle by the cap only. Place the tube in the proper orientation in the meter according to manufacturer's instructions. For some meters the tubes must be checked for their optical properties and best orientation prior to use. Before taking a reading make sure the lid or cap is placed firmly over the tube to prevent any stray light from entering the instrument. Stray light can interfere with the proper functioning of the instrument and result in inaccurate readings. You can check to see if the lid or cap is preventing stray light by measuring a standard in a dark room vs. full sunlight. There should be no significant difference between readings of the same standard in both conditions.

5. Between monitoring events wash the tubes with warm soap and water, rinse three times, and then perform a final rinse with distilled water. Invert to dry, then cap once completely dry.

The following is an example of field instructions on how to operate a specific turbidity instrument. It was provided by Heal the Bay's Stream Team and is provided as a model on how you can create field instructions for your turbidity instrument.

Turbidity Testing Procedure (Adapted from the LaMotte 2020 Turbidimeter Instruction Manual)
Before beginning please note that the turbidimeter has two operating modes, standard mode and EPA mode. These instructions are for units operating in the EPA mode (triangle icon displayed on the LCD). The meter can only be switched from one mode to the other while turning the 2020 on from the OFF state. The 2020 will remain in whatever mode it was last used in, even if it was turned off.

1) Fill a clean container with at least 50 ml. of sample water and cover. Set sample aside to allow sample to equilibrate to air temperature and let gas escape. Avoid contaminants and analyze as soon as possible.
2) Rinse 2 empty turbidity tubes and caps with a portion of sample. Shake out excess water.
3) Fill both turbidity tubes to the neck by carefully pouring the sample down the side of the tube. This will prevent air bubbles from forming. (Similar to pouring soda or beer into a glass while trying to avoid foam on the top).
4) Cap the tubes and wipe dry with a clean lint free tissue.

5) Carefully invert the turbidity tube twice (do not create air bubbles) just before inserting the tube into the meter,
6) Open the meter lid. Align the indexing arrow on the tube with the indexing arrow on the meter. Insert the turbidity tube into the chamber.
7) Close the lid. Push the READ button. The turbidimeter in NTU units will be displayed within 5 seconds.
8) Record the results from each tube. Take a third reading from a new sample if the first two readings are significantly different.
9) The meter will turn off automatically one minute after the last button push. To turn the meter OFF manually, hold the READ button down for at least2 seconds. Release the button when OFF is displayed.

Tip: For this meter if the sample is higher than 1100 NTU it must be diluted and retested.

Information Regarding the 2020 Turbidimeter Keypad

- When the READ button is first pushed, a number will be briefly displayed that indicates the software version number.
- Three dashes (---) will be displayed when the turbidity measurement is taking place.
- The display will flash after the CAL (calibrate) button is pushed during the standardization procedure until the CAL button has been pushed again to enter the adjusted value.
- OFF will be displayed after the READ button has been held down for two seconds. The button should be released and the meter turned off.
- ER1 (ERROR 1) will be displayed if the battery is low.
- ER2 will be displayed when the measured turbidity is very low.
- ER3 will be displayed when the light source (bulb) has burned out or if the turbidity tube is misaligned.
- BAT will be displayed when the battery is getting low. The readings are reliable but the battery needs to be replaced as soon as possible. Carry extra batteries with the field kit.

Heal The Bay, 2000, Water Quality Training Manual
LaMotte, 2000, 2020-Turbidimeter Instruction Manual