



Environmental Analysis Program

Pomona College
Biogeochemistry Laboratory

SOP-F205

Handheld Turbidity Meter

Standard Operating Procedure

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1. Purpose

This SOP describes the calibration, operation, and maintenance of handheld nephelometric turbidity meters for field measurement of water clarity. Turbidity is a standard water quality parameter required by the Surface Water Ambient Monitoring Program (SWAMP), NPDES permits, and many ecological studies (APHA et al., 2012). Field measurements complement laboratory analysis by providing an immediate on-site result.

2. Scope

- **Applies to:** Handheld nephelometric turbidity meters (e.g., Hach 2100Q, LaMotte 2020we, Oakton T-100) used for in situ and grab-sample turbidity measurements at EA Program field sites
- **Does not apply to:** Laboratory bench-top turbidimeters; Secchi disk transparency measurements (see [SOP-F207](#)); continuous turbidity sensors on multiparameter sondes (see [SOP-F200](#))
- **Location:** All EA Program surface water field sites

3. Responsibilities

Role	Responsibility
PI / Field Lead	Approve instrument selection; review QC data
Trained Personnel	Calibrate and operate the meter per this SOP
New Students	Complete training before independent use

4. Definitions

- **Formazin:** A synthetic polymer suspension used as the primary turbidity calibration standard; traceable to NIST; typically supplied as a 4000 NTU stock that is diluted to working standards; contains hydrazine and must be handled as hazardous waste (APHA et al., 2012).
- **Nephelometric turbidity:** Turbidity measured by the intensity of light scattered at 90° to an incident beam; the standard method per APHA Method 2130B; appropriate for samples with NTU < 40; for higher values a ratio or attenuation mode may be used (APHA et al., 2012).
- **NTU (Nephelometric Turbidity Units):** The unit of turbidity measured by a 90° nephelometer; numerically equivalent to FNU (Formazin Nephelometric Units) and approximately equivalent to FAU (Formazin Attenuation Units) at low concentrations (APHA et al., 2012).
- **RPD (relative percent difference):** $|A - B| / ((A + B) / 2) \times 100$; used to assess duplicate precision; acceptance criterion for field turbidity duplicates is RPD < 20% for readings above 10 NTU.
- **Silicone oil treatment:** Application of a thin film of silicone oil to the outside of a glass sample vial before measurement to fill surface scratches and reduce spurious light scattering; standard practice for glass vial meters (Hach Company, 2022).
- **StablCal:** A sealed formazin-based calibration standard supplied by Hach; stable and ready to use without dilution; available in < 0.1, 20, 100, and 800 NTU vials.

5. Safety and Hazards

Hazards

- **Physical:** Sampling near water involves slip and fall hazards.
- **Biological:** Water samples may contain pathogens. Wear gloves.
- **Chemical:** Formazin calibration standards contain hydrazine, a suspected carcinogen. Handle with gloves; dispose of as hazardous waste. StablCal sealed standards eliminate direct hydrazine exposure.

5.1. Required PPE

- ☐ Nitrile gloves
- ☐ Safety glasses (during calibration with bulk formazin)
- ☐ Closed-toed shoes or wading boots

5.2. Emergency Procedures

Refer to [SOP-F001 Field Safety](#). For formazin contact with skin or eyes, flush with water for at least 15 minutes and consult the SDS.

6. Equipment and Materials

Item	Notes
Handheld turbidity meter	Confirm model and battery level
Calibration standards	Hach StablCal sealed vials: < 0.1, 20, 100, 800 NTU; or prepared formazin dilution series
Sample vials (matched to instrument)	Glass or optical-grade; use only with the meter they were supplied with
Silicone oil and applicator cloth	For glass vials (Hach Company, 2022)
Lint-free wipes (Kimwipes)	For cleaning vials
DI water (squeeze bottle)	For rinsing vials and blanks
Waste container (labeled hazardous)	For used formazin waste
Field notebook	Per SOP-F003
Spare batteries	Matched to meter model

7. Procedure

7.1. Calibration

Calibrate at the start of each field day or after storage of more than one week (APHA et al., 2012).

1. Turn on the meter and allow it to warm up (approximately 1 minute).
2. Clean calibration vial exteriors with a lint-free wipe. Apply a thin, even film of silicone oil for glass vials.
3. Insert the lowest standard (< 0.1 NTU) into the sample chamber with the orientation mark aligned. Close the lid.
4. Press **Cal** and follow the on-screen prompts to read the standard.
5. Repeat with each subsequent standard in ascending order (e.g., 20, 100, 800 NTU).
6. When all standards have been read, the meter confirms a successful calibration. Record the date, standard lot number, and any correction factors in the field notebook.
7. Verify calibration by re-reading the 20 NTU standard; the reading must be within $\pm 10\%$ of 20 NTU. If not, repeat the full calibration.

7.2. Sample Collection

1. Collect a grab sample per [SOP-F300 Surface Water Sampling](#).
2. Avoid disturbing bottom sediments during collection.
3. Analyze as soon as possible; if delayed, keep the sample in the dark and analyze within 24 hours.

7.3. Measurement

1. Gently invert the sample container 3–4 times to resuspend particles uniformly. Do not shake vigorously (creates air bubbles).
2. Pour the sample into a clean sample vial to the fill line.
3. Cap and let sit for 1 minute to allow large air bubbles to rise.
4. Wipe the outside of the vial with a lint-free cloth. Apply silicone oil for glass vials.
5. Insert the vial with the orientation mark aligned. Close the lid.
6. Press **Read** and wait for the display to stabilize.
7. Record the result (NTU), sample ID, time, and site in the field notebook.
8. For samples above the meter range (typically > 1000 NTU), dilute with DI water, measure, and multiply by the dilution factor. Record both the diluted reading and the corrected result.
9. Rinse the vial three times with DI water between samples.

7.4. Post-Field Care

1. Rinse all sample vials with DI water; air-dry inverted.
2. Wipe silicone oil residue from vials before storage.
3. Store calibration standards in their original case, away from direct sunlight, at room temperature.
4. Turn off the meter; remove batteries if storing for more than one month.

8. Quality Control

- Calibrate at the start of each field day (§6.1) (APHA et al., 2012).

- Measure a DI water blank at the start and end of each sampling event; the blank must read < 1 NTU.
- Measure one field duplicate per 10 samples (minimum one per event); duplicate RPD must be < 20% for readings above 10 NTU.
- If the DI blank drifts above 1 NTU during the day, recalibrate and re-measure the most recent samples.
- Inspect sample vials for scratches before each use; scratches scatter light and produce false-high readings.

9. References

- APHA et al. (2012)
- Hach Company (2022)

APHA, AWWA, & WEF. (2012). *Standard methods for the examination of water and wastewater* (22nd ed., p. 1360). American Public Health Association.

Hach Company. (2022). *2100Q portable turbidimeter: User manual*. <https://www.hach.com/2100q-portable-turbidimeter/product?id=7640196322>

10. Related SOPs

SOP	Title	Relationship
F001	Field Safety	Required prerequisite
F207	Secchi Disk	Alternative transparency measure
F300	Surface Water Sampling	Sample collection procedures
L303	Hach Colorimetric Analysis	Lab-based Hach methods

11. Training Record

Before using turbidity meters independently, personnel must:

1. Read this SOP in full
2. Demonstrate a complete calibration using StablCal or formazin standards
3. Perform supervised field measurements at one site
4. Be signed off by the PI or field lead