

HF SCIENTIFIC TURBIDIMETER MAINTENANCE AND CALIBRATION

MAINTENANCE & CALIBRATION: HF TURBIDIMETERS

Rev. 4/5/16

These procedures are to be performed by Streamkeeper staff or trained volunteers. Calibrate the turbidimeters before every quarterly monitoring season. **Be sure the primary reference standards used in the office for calibration are within their expiration dates (last day of listed month), and the secondary (field kit) reference standards won't expire before the end of the next monitoring season. If not, notify office staff to order new standards.**

EQUIPMENT NEEDED:

- "Turbidimeter Calibration Protocol & Data Sheets" notebook
- HF Scientific Turbidimeters, models DRT-15CE and/or DRT-15C—preferably charged prior to calibration
- Sealed secondary field standards for each meter—each meter should have a "low" vial in the .02 NTU range and a "high" vial in the 10 NTU range
- Kimwipes & glass cleaner
- Vials marked for the primary standards. These vials should already have index arrows on their caps, individualized for each machine—if they do not, you will have to index them using the instructions below. ***After removing any cap, be sure to replace it on the same vial!***
- Primary reference standards appropriate to the meter:
 - For the 15CE, NTUs of 0/10/100/1000
 - For the 15C, NTUs of 0/20/200These will either consist of polymer standard solutions, or, if you are using Formazin to make calibration standards, you will need to use the Environmental Health Lab (arrange for counter space for $\frac{1}{2}$ day) and will also need:
 - safety goggles & gloves
 - turbidity free water
 - pipettes of different sizes
 - pipette suction bulbs
 - volumetric flasks

CALIBRATION PROCEDURE:

- 1) Warm up turbidimeters for 15 minutes before calibrating. If the units are not charged, you can run them with their charging units plugged in. ***NOTE: Do not plug in turbidimeter with transformer plugged into wall.***
- 2) ***If you are using Formazin***, prepare calibration solutions, using the Formazin dilution chart in the instruction manual:
 - a) Put the suction bulb on the appropriate pipette.
 - b) Use the pipette to measure Formazin into the appropriate volumetric flask (or 400-ml beaker).
 - c) Fill the rest of the flask with turbidity-free water, to the volume stated on the chart.
 - d) Swirl the solution and label the flask.
- 3) If you're using polymer solutions, they'll be either in already-prepped vials or bottles from which you'll have to prepare vials. If the latter, see "Standard Vial Preparation" procedure following this section.
- 4) When all vials have been prepared, calibrate each turbidimeter individually, following instructions for that model. Here are the instructions for the DRT-15CE:

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- a) Put the 0.02 NTU vial in the chamber.
- b) Flip the Range switch back and forth from 0 - 1000 about ten times, to knock away any corrosion that might have built up on the switch contacts.
- c) To gain access to the trimpots, remove the accessories from the foam holder.
- d) Refer to the following figure for trimpot identification:

Recorder output
—0-1000
—0-100
—0-10
Reference offset
—Low battery

- e) Turn the DRT-15CE to the 0 - 10 Range.
 - f) If you haven't already, index the calibration vials for each meter as described above.
 - g) Set the Reference Adjust to the maximum "up" position.
 - h) If the display does not read 0.18 NTU, adjust the R2 Ref. Offset trimpot until it does.
 - i) Set the Reference Adjust to 0.02 NTU.
 - j) Insert the 10 NTU standard and index. Adjust R11 (0 - 10 NTU gain) to obtain a reading of 10.00 NTU.
 - k) Rotate the range switch to the 100 NTU range. Replace the 10 NTU standard with the 100 NTU standard and index it.
 - l) Adjust R12 (0 - 100 gain) to obtain a reading of 100.0 NTU.
 - m) Rotate the range switch to the 1000 NTU range. Replace the 100 NTU standard with the 1000 NTU standard and index it.
 - n) Adjust R13 (0 - 1000 gain) to obtain a reading of 1000 NTU.
 - o) It is not necessary to adjust R37 (low battery indicator). This is factory set to indicate a low battery condition when the battery voltage is < 5.6 V.
 - p) **WARNING:** R41 is factory set. Adjustment of this trimpot could cause damage to battery and/or DRT-15CE.
- 5) Once each meter has been calibrated, clean its sealed secondary "low" and "high" reference vials and take readings for them; the company guarantees that they will read within 20% of their listed value. (If they don't, contact the company.) On a piece of tape on the cap that includes a properly-oriented index arrow, write "Ref. Std. [reading on meter] NTU / DO NOT OPEN!" Record these readings for the secondary standards in the calibration notebook.
- 6) Put a new label on the control panel of the turbidimeter, reading "Last Calibration [date][initials]."
- 7) After calibrating:
- a) ***If you are using Formazin:***
 - i) Pour the Formazin into the sink.
 - ii) Rinse vials, flasks, and pipettes with tap water, then distilled water.
 - iii) Fill vials with distilled water, cap, and store.

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- b) *If you are using polymer solutions*, leave these solutions in the vials to store them.

CALIBRATION TROUBLESHOOTING:

If you are having trouble calibrating the instrument, you may have one of the following problems—consult staff:

- The battery may need charging, or, if it was fully charged before calibrating and then shows “Lo Bat” during the procedure, replace it.
- Photo diodes may be loose. Check leads to circuit board from detectors in optical block, by plucking gently.
- Lamp may need replacing, particularly if you are having trouble calibrating at the high end.

QUARTERLY SAMPLE VIAL INTEGRITY CHECK:

Prior to each monitoring season, make sure that the meters' sample vials have not been compromised:

- 1) Check each sample vial and replace any with scratches or discoloration.
- 2) Clean the sample vials with LiquiNox (or 2N hydrochloric or nitric acid for stubborn dirt/stains) and rinse well with purified water. Then fill them with purified water, preferably directly from the water purifier, and record the readings. Any vial reading 0.1 or higher should be replaced. Any replacement vial, when filled with purified water, should read no more than 0.01 outside the range of the other sample vials. (It's possible that all the sample vials may have to be replaced.)

ANNUAL VIAL CLEANING/REFILLING:

As of 2009, Streamkeepers is purchasing polymer-based turbidity standard solution in bulk and filling vials for both primary and secondary standards in the same manner. They are to be cleaned, filled, and then left sealed until their expiration dates (usually one year).

CLEANING:

- 1) Put all vials through this same cleaning procedure, including sample vials.

SAMPLE VIAL MATCHING:

REFILLING: Unsealed vials will need to be filled with fresh solution.

- 1) Pour out the old solution from them.
- 2) Fill $\frac{1}{4}$ full with the appropriate fresh solution, recap, agitate, and discard.
- 3) Refill and recap with fresh solution.

INDEXING:

- 1) Once you've performed cleaning and refilling, you'll have to re-index all of the vials. This is a process whereby you mark the orientation of the vial that yields the best light transmission through the meter. The sample vials and secondary standards are indexed for the meters they belong to; the primary standards must be indexed for every different meter.
 - a) Fill all sample vials with purified water. Then, for each meter, perform the following procedures with its sample vial, its low and high secondary

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standards, and all of the office primary standards.

- b) Set the meter to the appropriate range for the contents of the vial.
- c) Put the vial into the well.
- d) Note the meter reading.
- e) Make a small pencil mark on the cap at the point nearest to the white locator pin on the rim of the well.
- f) Slowly rotate the vial while observing the meter reading, and make a new mark every time you get to a new lowest reading. When you arrive back at your first mark, it's a good idea to go back around backwards, to recheck the lowest-reading point. Once you have confirmed that point, put a small arrow on the cap (with a piece of tape if necessary) pointing to that point; if the vial is a primary standard, label that arrow with the number of that meter.

POST-SEASON MAINTENANCE:

At the end of each monitoring season, open each meter, remove the foam rubber, turn upside down and shake to empty out any accumulated dirt or debris, and wipe surfaces clean if dirty. Wash sample vial inside and out with warm water and a small amount of dish soap. Rinse well with tap water and then purified water, air dry if possible, then replace the cap.

POST-SEASON CALIBRATION CHECK AND QUALITY CONTROL:

At the end of each monitoring season, re-check the integrity of the meters by testing with primary standard solutions. They must

meet the control limits in Streamkeepers' Quality Assurance Project Plan: the readings on the meters need to be within ± 0.5 or 5% of the value of the fresh primary standard. If any meter performs outside these limits in any data range (e.g., 0-10, 10-100, 100-1000), all data from the previous monitoring season that falls within that range must be qualified as an "estimate" ("EST"). And if the meter does not perform to ± 1.0 or 10% of the standard value in any of its data ranges, all data from the previous monitoring season that falls within that range must be flagged as "rejected" ("REJ").

TROUBLESHOOTING FIELD-CHECK FLAGS DURING THE MONITORING SEASON:

Streamkeepers' field protocol calls for a check of the meter with a sealed secondary standard in the range of 8-10 NTU. If the field-check differs from the value on this standard by more than 10%, the data gets a preliminary flag and staff is notified.

Testing is then performed to determine whether drift has occurred in the secondary standard, the meter, or both:

- If the standard has drifted, it should get relabeled with its new value, or replaced if it falls outside the manufacturer's performance criteria.
- In the above case, if the meter has not drifted beyond its control limits, the data can be relabeled as Acceptable and the meter be put back in service.
- If the meter has drifted, data should be flagged per QC criteria listed in the above section, and the meter should be recalibrated or taken out of service for the remainder of the monitoring season.

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As possible, observe the meter over the next few weeks to see if it continues to drift.

TURBIDIMETER CALIBRATION PROTOCOL & DATA SHEETS NOTEBOOK:

Record all calibration, quality-control, and maintenance activity in the Turbidimeter Calibration Protocol & Data Sheets notebook. In the case of calibration, record the type of calibration solution, vendor, expiration date, and readings on the secondary field standards. This provides confirmation that the secondary field standards were checked.

You are responsible for entering all maintenance and calibration data into the database and notifying program staff if any data from the preceding sampling period needs to be qualified per QAPP requirements.