DOCUMENT TYPE: Standard Operating Procedure

DOCUMENT CLASS: Physical Property Procedure

TITLE: Portable Turbidimeter, Model 2100
US EPA, Method 180.1

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1. Scope and Application

1.1. This method is applicable to the analysis of drinking, surface and saline waters in the range of 0 to 1000 nephelometric turbidity units (NTU).
1.2. More turbid samples should be diluted prior to analysis.

2. Summary of Method

2.1. The method is based upon a comparison of the intensity of light scattered by the sample under defined conditions with the intensity of light scattered by a standard reference suspension under the same conditions.
2.2. The higher the intensity of scattered light, the higher the turbidity.
2.3. StablCal standard suspensions are used to create a calibration curve.
2.4. Samples are transferred to sample cells that are carefully wiped free of dust and moisture.
2.5. Cuvettes are inserted into the chamber with a consistent orientation.
2.6. Turbidity units are recorded according to results. (See Results, p.5)

3. Comments

3.1. NTU's are considered comparable to the previously reported Formazin Turbidity Units (FTU) and Jackson Turbidity Units (JTU).
3.2. Dark glass sample cell should be handled by the securely fastened lid.
3.3. Store StablCal standards at room temperature, preferably in drawer labeled Turbidity in 29 Palms Laboratory.
3.4. Keep lit closed when not in use.
3.5. Make sure that there are no air bubbles in sample cell before placing into Turbidimeter.
3.6. Wipe sample cell well with Kimwipe to remove any fingerprints, and apply a drop of silicone oil to exterior of cell to mask any minor imperfections in the surface.
3.7. A Formazin calibration should done once every 3 months

4. Sample Handling and Preservation

4.1. Preservation of the sample is not practical; analysis should begin as soon as possible.
4.2. Refrigeration or icing to 4^{o}C, to minimize microbiological decomposition of solids is recommended.

5. Interferences

5.1. Coarse floating debris that settles out rapidly will give unstable low readings.
5.2. Presence of color in sample water due to dissolved substances that absorb light will cause turbidities to be low.
5.3. Air bubbles will cause higher turbidity readings.

6. Apparatus

6.1. Portable Turbidimeter, Model 2100P
6.2. Silicone Oil
6.3. Oiling cloth
6.4. Quick reference card
6.5. Four AA batteries

7. Reagents

7.1. Reagent Water (NanoPure)

7.2. StablCal Turbidity Standards: ≤0.1-NTU, 20-NTU, 100-NTU, 800-NTU

8. Procedure

8.1. Turn instrument on

8.2. Calibrate the meter.

8.2.1. Insert the "0.1" turbidity sample cell calibration standard into the cell compartment by aligning the orientation mark on the cell with the mark on the front of the cell compartment.

8.2.2. Close shield.

8.2.3. Press CAL and the CAL and S 0 icons will be displayed with the "0" will be flashing.

8.2.4. Press READ on keypad.

8.2.4.1. The instrument will count from 60 to 0, read the blank and use it to calculate a correction factor for the next standard measurement. The display will automatically increment to the next standard.

8.2.5. Remove sample cell.

8.2.6. The display will show S 1 with the "1" flashing and the 20 NTU value.

8.2.7. Insert the "20" cell into the well compartment and close cover.

8.2.8. Press READ.

8.2.8.1. The instrument will count from 60 to 0, read the blank and use it to calculate a correction factor for the next standard measurement. The display will automatically increment to the next standard.

8.2.8.2. If the value is incorrect, edit the value by pressing the → key to scroll to the correct number.

8.2.8.3. Repeat sample reading with new 20 NTU standard.

8.2.9. Remove sample cell.

8.2.9.1. The display will show the S 2 with the "2" flashing.

8.2.10. Insert "100" NTU standard sample into the well compartment.

8.2.11. Press READ.

8.2.11.1. The instrument will count from 60 to 0, read the blank and use it to calculate a correction factor for the next standard measurement. The display will automatically increment to the next standard.

8.2.11.2. If the value is incorrect, edit the value by pressing the → key to scroll to the correct number.

8.2.12. Remove calibration sample cell.

8.2.12.1. The display will show the S 3 with the "3" flashing and 800 NTU for the next sample.

8.2.13. Place 800 NTU calibration sample cell into well compartment.

8.2.14. Press READ.

8.2.14.1. The instrument will count from 60 to 0.

8.2.14.2. The display will then increment back to SO.

8.2.15. Remove calibration sample cell.

8.2.16. Press CAL to accept the calibration.

8.3. Preform Calibration Curve

8.3.1. Place a known standard in cell compartment

8.3.2. Press READ
8.3.3. Record Value
8.3.4. Place different known standard into cell well.
8.3.5. Press READ
8.3.6. Record Value
8.3.7. Repeat 8.3.1 three more times for a total of five recorded values.
8.3.7.1. Proceed to section 9.0 for calculations

8.4. Take sample readings.
8.4.1. Fill sample cell to white horizontal line with sample.
8.4.2. Wipe sample cell well with Kimwipe and lightly oil with silicone and wipe off.
8.4.3. Insert sample cell with vertical line forward.
8.4.4. Close lid.
8.4.5. Press READ
8.4.6. Record value of sample in NTU's.

9. Calculation

9.1. Using Excel graph the difference between the expected NTU value and the recorded actual value to find the slope. (See section 12.0 for Calibration Curve)

9.2. If created diluted sample.
9.2.1. Multiply sample readings by appropriate dilution to obtain final reading.
9.2.2. Sample calculation: If sample is diluted in half (1:1), the turbidity result would be the value displayed multiplied by two.
9.2.2.1.Diluted sample turbidity reading: 5.4.
9.2.2.2.Turbidity (NTU)= 5.4 x 2 = 10.8 NTU
9.2.2.3.Reported as 11 NTU (See Results p.5)

10. Results

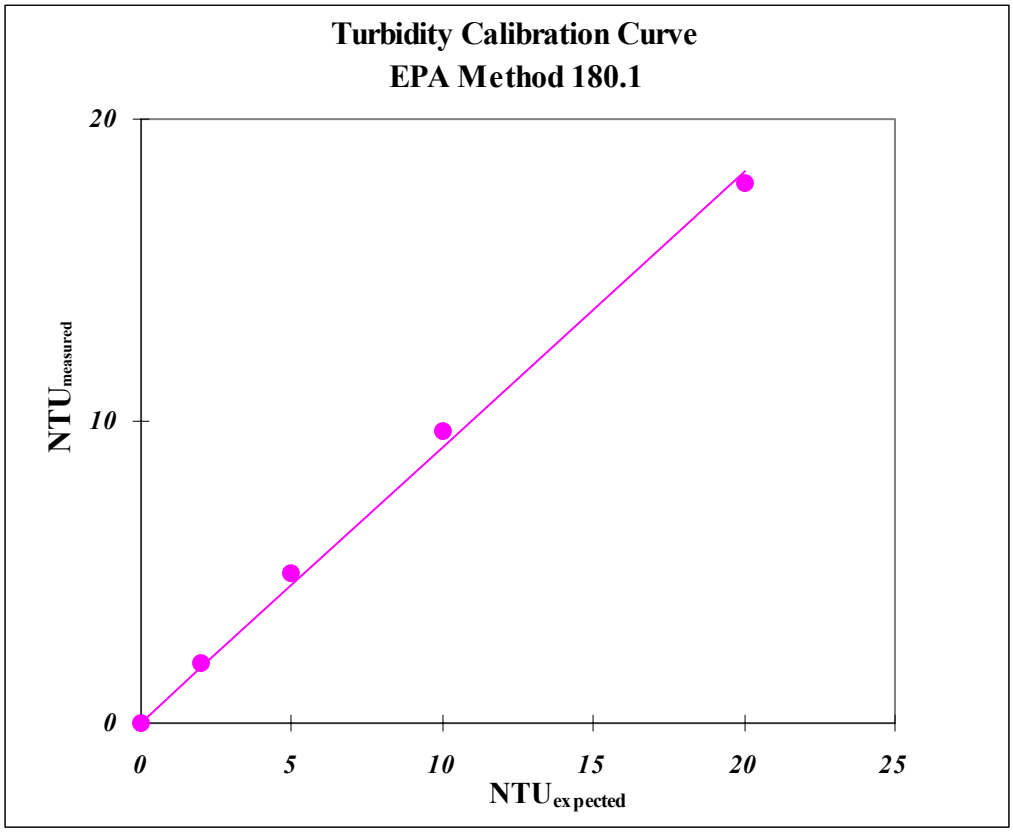
10.1. Report results as follows:

NTU	Record to nearest:
0.0-1.0	0.05
1-10	0.1
10-40	1
40-100	5
100-400	10
400-1000	50

11. Bibliography

11.1. Hach Company Manual for Portable Turbidimeter, Model 2100P (Cat. No. 46500-88)
11.2. EPA Method 180.1
11.3. Hach Quick Reference Card for Portable Turbidimeter.

12. Calibration Curve



Turbidity Expected (NTU)	Measured Turbidity (NTU)	RF	
0.00	0.00	-	Average RF =0.964
2.00	2.00	1.000	Std. Dev. =0.0492
5.00	4.97	0.994	Relative % Std. Dev. =5.10
10.00	9.68	0.968	R^2 =0.997
20.00	17.86	0.893	m =0.913
			y-intercept =0.00