

Uranium Testing and Site Calibration for Water Testing Detection Range: 2 – 60ppb

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2 General Information

Important: Before continuing, please read the entire *ANDalyze Fluorimeter User Manual*. Pay attention to all danger, warning and caution statements. Failure to do so could result in serious injury to the operator or damage to the equipment. Make sure that the safety features of this equipment are not impaired; do not use or install this equipment in a manner other than that specified in this manual. If the equipment is used in a manner not specified by the manufacturer, the safety features of this equipment may be impaired and injury to the operator or damage to the equipment may result.

2.1 Water Testing Guidelines

Note: The below steps are for testing for dissolved, bio-available metal ions in drinking water samples. These steps can also be used for other matrices such as surface, ground, industrial and wastewater which have been pre-treated. Contact ANDalyze customer service for additional application notes on pre-treatment methods.

Water Sampling

For best results use freshly collected sample (unpreserved in acid) for analysis. We recommend that you use the sample within 1 hour (maximum of 2 hours) of collection to minimize any metal loss to the walls of the sample container. This is particularly important for testing trace uranium levels (Contact ANDalyze customer service for the citation to a peer reviewed publication about loss of uranium to container walls). Large volumes (1L) may be stored up to 12 hours in HDPE containers in a refrigerator or cooler with ice packs if required.

Once the sample is mixed with ANDalyze sample buffer, test within 15 minutes.

Temperature Range

ANDalyze test kits typically work with water samples at 17 – 35 °C (63 – 95 °F). However, the most accurate and precise results are obtained when the sample is in the range of 20 - 25 °C (68 – 77 °F). A change in sample temperature of several degrees will require an on-site calibration to be performed.

pH Range

The ANDalyze sample buffer that is provided in the sample tubes brings the pH of the test solution to pH 5.5. The uranium sensor has the best uranium recovery if the raw sample is brought to a pH of 4 - 6, so that the uranium is present as dissolved uranium. (If you're testing environmental water, such as surface water or ground water, filter the sample first and then adjust the pH. Please refer to ANDalyze Environmental Water Solution Note for details). Please check the pH first to confirm it is within the range prior to mixing with the ANDalyze buffer. The final buffered test solution should be pH 5.5 for best results.

Note: Our tests have shown that environmental samples preserved in acid to a pH < 2 cannot be brought to a pH of 5.5 when mixed with the ANDalyze buffer. These samples have to be first neutralized with NaOH to a pH ~4 before mixing with ANDalyze buffer. Please contact ANDalyze customer service for additional application notes on pre-treatment methods.

2.2 Sensor Pack: Cuvette and Sensor

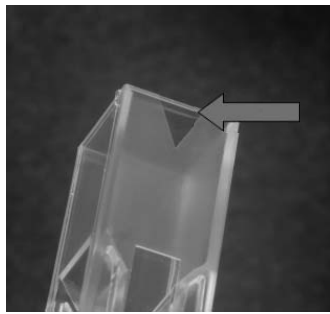
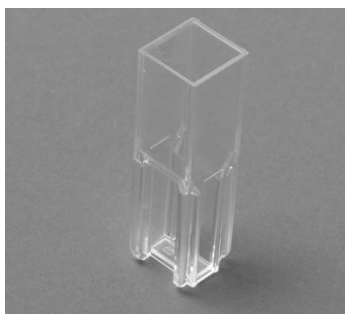
Sensor Pack: Each sensor pack contains a cuvette, a sensor and a desiccant. These are **single use** and must be discarded. The desiccant should be blue in color. If it has turned completely pink in color, the sensor may not perform well.



2.3 Inserting Cuvette and Sensor

Cuvette: The cuvette has an arrow which should face you when inserted. Insert the cuvette completely so that the fluorimeter lid can close. The meter and cuvette design helps to prevent improper orientation.

Sensor: The square portion of the sensor can be placed on the cuvette in any orientation with the round sections facing upward. Sensors can only be used once and should be disposed of immediately after use.



2.4 Sample Injection and Measurement

The ANDalyze Fluorimeter should be **laid flat** on a stable surface during a measurement

A buffered solution is prepared in a sample tube as described in the On-Site Calibration section (3) and test section (4) and this is used for measurements

A new 1 mL syringe should be used to withdraw 1 mL buffered sample water from a sample tube. This syringe can be attached to the top of the housing as shown in the picture.

The sample should be injected through the housing into the cuvette at a constant speed of **3 – 5 seconds**. The syringe and housing should be immediately removed and the sample door closed. The **START** button located just below the screen should be pressed immediately to start any measurement.

Important: After each analysis, discard all components used during the analysis including cuvette, sensor housing, sample tube, and syringes to avoid cross contamination.



2.5 Pipette Use Guidelines

- 1. New Pipette Tip** – Attach a new tip by placing the end of the pipette into one of the available tips and pressing down on the pipette body.

Note: Tips are disposable and should never be used more than once. Use of tips helps prevent contaminating the pipette.



- 2.** Depress the plunger button on the top to the first stop (see photo at left). **DO NOT depress all the way to the pipette body.**
- 3.** Immerse the clean tip into the solution to be withdrawn.
- 4.** Release the pressure slowly to withdraw the solution into the tip.

Important: Make sure that the pipette tip continues to be immersed in the solution during release so as to not expose the tip point to air.

- 5.** Remove the pipette from the solution.

Note: The liquid level in the tip should be approximately at the 3rd graduation.

- 6.** Immerse the tip into the liquid present in the sample tube where the withdrawn solution is to be dispensed.
- 7.** Slowly depress the operating button **ALL THE WAY** to dispense the liquid contained in the pipette tip. (See photo at right)
- 8.** Remove the pipette and discard the used tip.

Note: Dispose of tips immediately after use to prevent possible contamination of the pipette.



3 On-Site Calibration

3.1 Required Materials

- ANDalyze Fluorimeter
- (2) Sensor Packs with Sensor & Cuvette
- (2) 1mL Syringe
- (2) Sample tubes (with buffer)
- (1) Transfer Pipette
- Uranium Standard Solution (1.4 ppm)
- 100 µL Fixed Volume Pipette and Tips
- (1) Clean sample collection cup (Not Provided)



3.2 Preparing for On-Site Calibration

When testing water at a new location, the instrument has to be calibrated for accurate readings. Completing the On-Site Calibration requires two separate solutions and tests. At the end of the process, the fluorimeter is calibrated for testing water at that site and also provides the test results for the site. A calibration may only be accurate when originally performed, as changes in the sample matrix, temperature, and sensor lot will affect the results. Do not rely on a calibration to be accurate over days as environmental samples can vary greatly. If in doubt, perform On-site Calibration

Important: On-Site Calibration must be performed if testing is being done:

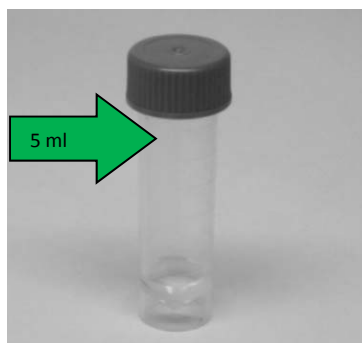
- At a new location which has not been previously saved.
- To adjust for significant changes in sampling temperature.
- When beginning to use a new lot of sensors.

1. Site: Select the site to be tested or enter a new site as described in Section 5 of the *ANDalyze Fluorimeter User Manual*

2. Collect Sample Water – In a clean sample cup, collect a small volume of water to be tested.

3. Prepare Calibration Solutions – Slowly pour the test water into **two sample tubes** containing the liquid buffer up to the 5 mL mark. If required, use one of the provided disposable plastic pipettes to transfer water accurately. **Do not exceed the 5 mL mark for accurate results.**

Important: Open tube carefully so that liquid buffer does not spill out.



One tube will be used for analyzing a sample spiked with Uranium and the other for analyzing an unspiked sample.

3.3 On-Site Calibration: Sample with Uranium Spike (Step 1 of 2)

1. Attach a **new** tip to the 100 μ L fixed volume pipette.
2. Withdraw 100 μ L of the Uranium Standard Solution from the bottle using the pipette.
3. **Mix** - Transfer the 100 μ L spike into one of the sample tubes filled with buffered sample water.
4. **Shake** - Close cap and shake well. For most accurate results, wait 5 minutes before testing. Metal standard spiked for on-site calibration is **required** to incubate for all environmental water samples.



Withdrawing Standard Solution Using Pipette

Transferring Spike Solution to Sample Tube



Important: Open tube carefully so that liquid does not spill out.

5. **Pouch** – Open the sensor pack which contains the sensor (colored plastic housing) and plastic cuvette.
6. **Cuvette** – Place the plastic cuvette in the ANDalyze Fluorimeter.
7. **Sensor** - Place colored plastic sensor on the cuvette (Any orientation). Make sure sensor is seated securely on the cuvette.
8. Enter the Site Calibration screen (as seen in photo to the right) which will appear once a new site has been entered (See Section 5 of *ANDalyze Fluorimeter User Manual*).

Important: Do not press **START** until the sample is ready. Follow steps below.

Note: If the unit is left on for more than a few minutes without any activity, a screen-saver (black screen) will be activated; press any button to resume operation (Do not press and hold ON/OFF). The instrument automatically turns off if not used for more than 5-15 minutes (user settable).



9. **Test** - With one of the provided 1 mL syringes, draw 1 mL buffered sample water from the spiked sample tube into the syringe.
10. Attach the syringe to the housing over the cuvette in the instrument. Maintaining a constant speed (over 3-5 seconds), carefully squeeze the sample water through the housing into the cuvette. Quickly remove sensor housing and syringe and close sample chamber door. Immediately press the **START** button located just below the screen. Remove the cuvette when complete.

3.4 Site Calibration: Unspiked Sample Test (Step 2 of 2)

The Site Calibration screen (as seen in photo to the right) will appear once Step 1 of 2 has been completed for a new site.

DO NOT press START until the second sample is ready for injection!

1. Open a **NEW** sensor pack and place the plastic cuvette in the Fluorimeter and the colored plastic sensor on the cuvette. Make sure sensor is seated securely on the cuvette.
2. With one of the provided 1 mL syringes, draw 1 mL buffered sample water from the **second unspiked sample tube** into a new syringe.
3. Attach the syringe to the housing over the cuvette in the instrument. Maintaining a constant speed (over 3-5 seconds), carefully squeeze the sample water through the housing into the cuvette. Quickly remove sensor housing and syringe and close sample chamber door. Immediately press the **START** button located just below the screen. Remove the cuvette when complete.
4. All waste produced during the test can be disposed of in normal public receptacles. Materials and liquids used are not considered harmful to people or the environment and do not require special disposal. The plastic waste is made from recyclable plastics and can be disposed of per local guidelines.



3.5 Applying Results

The results display the site name, a calibration factor associated with that site, and the Uranium test results for the water sample used during this process.

Note: The results displayed are for the sample water and not for the sample water containing the spike. **The results should be treated as an actual test and can be seen in the results menu screen.**

To save the factor associated with this site, press **APPLY**.

On-Site Calibration from this site has been saved. You are now ready to test more samples from this site.



4 Testing a Sample

This section will walk you through the process of testing a water sample for the desired analyte. Please read this entire section before beginning the test as parts of the test will be time sensitive. Be aware and pay attention to all notes.

4.1 Required Materials

- ANDalyze Fluorimeter
- (1) Sensor Pack with Sensor & Cuvette
- (1) 1 mL Syringe
- (1) Sample tube (with buffer)
- (1) Transfer Pipette
- (1) Clean sample collection cup (Not Provided)



Note: Before using the ANDalyze Fluorimeter assure that it is charged. (See Section 4.1 in the *ANDalyze Fluorimeter User Manual* for Battery Charging Information)

4.2 Testing a Sample

1. **Start-Up** - Initialize the instrument by pressing the ON/OFF button. Instrument will initialize in about 1-2 seconds.
2. **Sensor Type** - Ensure that the fluorimeter is on the correct sensor screen.
3. **Site** – Confirm that the site being tested is correct.



Unless the Instructional Screens are turned ON, Do Not press START until the sample is ready!

4. **Pouch** - Open the sensor pack which contains the sensor (colored plastic housing) and plastic cuvette.

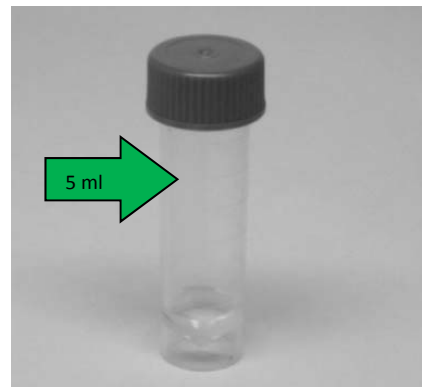
Important: The pack contains a transparent desiccant pouch. This should be blue in color. If desiccant has turned completely pink in color, the sensor may not perform well.

5. **Cuvette** - Place the plastic cuvette in the instrument.
6. **Sensor** - Place colored plastic sensor on the cuvette. (Any orientation). Make sure the sensor is seated securely on the cuvette.



Note: Unit may go into screen-saver mode after a few minutes. Press any button to resume (Do not press and hold ON/OFF).

7. **Sample Tube** – Collect water to be tested in a clean cup (not provided).
8. Slowly pour the test water into the provided sample tube containing liquid buffer up to the 5 mL mark. If required, use one of the provided disposable plastic pipettes to transfer water accurately without exceeding 5 mL volume mark. Close cap tightly and mix well by shaking.



Important: Open tube carefully so that liquid buffer does not fall out. Do not exceed the 5 mL mark for accurate results.

9. **Syringe** - With one of the provided syringes, draw 1 mL of buffered sample water from the sample tube into syringe.
10. Attach the syringe to the housing over the cuvette in the instrument. (Syring tip will fit into top of sensor)



Note: If the unit is left on for more than a few minutes without any activity, a screen-saver (black screen) will be activated; press any button to resume operation (Do not press and hold ON/OFF). The instrument automatically turns off if not used for more than 5-15 minutes (user settable).

11. Maintaining a constant speed (over 3-5 seconds), carefully squeeze the buffered sample water through the housing into the cuvette.
12. Quickly remove sensor housing and syringe and close sample chamber door.
13. Press the **START** button located just below the screen immediately.
14. Remove cuvette when complete.

4.3 Results

The sample will be tested, and results displayed in parts per billion (ppb) or parts per million (ppm) in under a minute.

To save the results, press the **SAVE** button.

Note: A reading of “Below 2ppb Limit” or “Above 100ppb Limit” indicates the amount of Uranium in the sample is outside the recommended detectable levels of the instrument.



4.4 Waste Disposal

All waste produced during the test can be disposed of in normal public receptacles. Materials and liquids used are not considered harmful to people or the environment and do not require special disposal. The plastic waste is made from recyclable plastics and can be disposed of per local guidelines.

5 Technical Specifications for ANDalyze Sensors

5.1 Detection in Drinking Water

ANDalyze’s proprietary catalytic DNA sensor uses a DNAzyme reaction that fluoresces in the presence of the target contaminant (lead, uranium, copper, etc). The fluorescence of the reaction is measured using the ANDalyze fluorimeter to determine the concentration of the free analyte ion (Pb^{2+} , UO_2^{2+} , Cu^{2+} , etc.) in solution and is reported in parts per billion (ppb) or parts per million (ppm).

Materials Used

- ANDalyze Fluorimeter
- Uranium Sensor Kit
- Analyte/Metal Standard Solution



Sensor

Associated US Patents

8,815,156B2, 6,706,474, 7,192,708,
6,890,719, 7,332,283

Performance

Uranium dilutions containing 0 - 60 ppb Uranium (dissolved as UO_2^{2+}) were prepared in DI water. Five replicates were used for each test at each dilution.

Limit of Detection (LOD)

1 ppb uranium
Based on 3 sigma method

Precision

Standard: 30 ppb uranium
95% Confidence Limits: 25 – 35 ppb uranium

Limit of Quantification (LOQ)

2 ppb uranium
Based on 10 sigma method

Coefficient of Variation (CV):

0–80 ppb uranium $\pm 15\%$ or 2ppb, whichever is greater
Note: This data is for tests in DI water. Environmental and other matrix variations will be higher.

Linear Detection Range

2 - 60 ppb uranium

Note: All specifications are subject to change without notice.

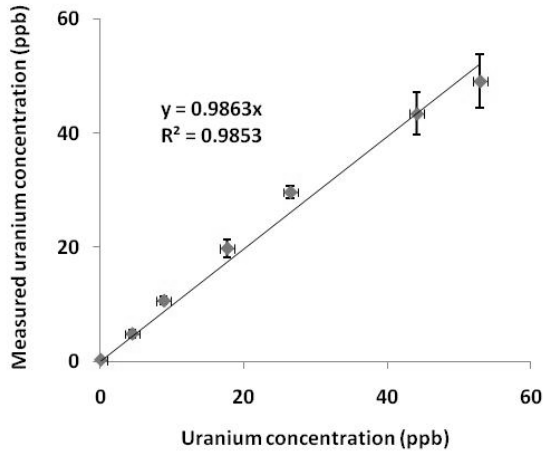
5.2 Interference

Interference tests were done with a 30 ppb U solution (as UO_2^{2+}) plus the potential interfering ion. The interference tolerance levels represent the concentration above which the U concentration is changed to $\pm 10\%$. Data represents an average of at least three replicates. For each interference test, an On-Site Calibration with the particular water matrix (containing the interfering ion) was performed.

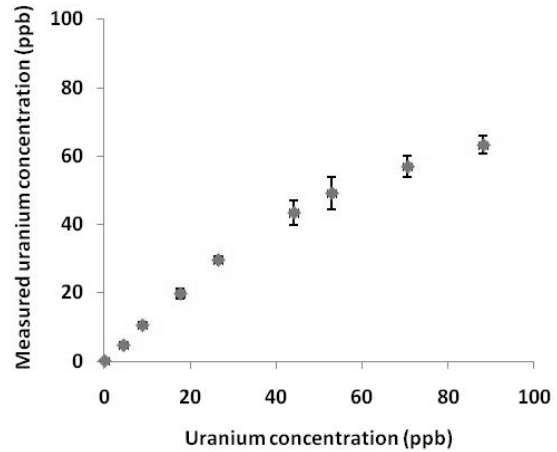
Interfering ion	Interference level
Calcium, Ca^{2+}	1000 ppm
Magnesium, Mg^{2+}	375 ppm
Zinc, Zn^{2+}	30 ppm
Aluminum, Al^{3+}	0.05 ppm
Copper, Cu^{2+}	2 ppm
Iron, Fe^{3+}	0.3 ppm
Cadmium, Cd^{2+}	5 ppm
Mercury, Hg^{2+}	30 ppm
Manganese, Mn^{2+}	0.025 ppm
Ammonium, NH_4^+	1000 ppm
Carbonate, CO_3^{2-}	50 ppm
Phosphate, PO_4^{3-}	5 ppm
Chloride, Cl^-	500 ppm
Sulfate, SO_4^{2-}	200 ppm

5.3 Product Accuracy Ranges

The graphs below depict the average measured uranium concentration as displayed on AND1000 fluorimeter (y-axis) vs. the known concentration of the uranium standards (x-axis). Error bars depict the standard deviation from five measurements. Graph 1 shows the linear range of 0 - 60 ppb uranium. For higher concentration of uranium (tested up to 90 ppb uranium), the accuracy decreases (Graph 2). Samples containing higher than 60 ppb uranium can be diluted 1:1 and re-analyzed.



Graph 1: Average uranium Conc. vs. Known Conc.



Graph 2: Accuracy vs. Linear Detection Range

6 Consumables and Replacement Items

- Fluorimeter (Part Number: AND002)
 - o Capable of measuring multiple metals.
 - o Includes:
 - Fluorimeter
 - USB to MINI-B Cable
 - 100 μ L Fixed Volume Pipette and Tips
 - pH Test Strips

- Sensor Kit (Part Number: AND011)
 - o Equipment for (25) Tests and/or Calibrations
 - o Kit Includes:
 - (25) Sensor Packs with Sensor & Cuvette
 - (25) Sample tubes (with buffer)
 - (25) 1 mL Syringes
 - (15) Disposable Transfer Pipettes
 - 5 mL Uranium Standard Solution (1.4 ppm uranium)
 - Instruction Manuals
 - Material Safety Data Sheets (MSDS)

7 Customer Service Contact Information

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