Barium

DOC316.53.01007

Turbidimetric Method[1]

Method 8014

2 to 100 mg/L Ba

Powder Pillows

Scope and application: For water, wastewater, oil and gas-field water and seawater.

[1] Adapted from Snell and Snell, Colorimetric Methods of Analysis, Vol. II, 769 (1959).

Test preparation

Instrument-specific information

Table 1 shows all of the instruments that have the program for this test. The table also shows sample cell and orientation requirements for reagent addition tests, such as powder pillow or bulk reagent tests.

To use the table, select an instrument, then read across to find the applicable information for this test.

Table 1 Instrument-specific information

Instrument	Sample cell orientation	Sample cell
DR 6000 DR 3800 DR 2800 DR 2700 DR 1900	The fill line is to the right.	2495402 
DR 5000 DR 3900	The fill line is toward the user.	
DR 900	The orientation mark is toward the user.	2401906 

Before starting

For turbidimetric methods, install the instrument cap or cover on all instruments before ZERO or READ is pushed.
Use the Standard Adjust option with each new lot of reagent for the best results. Refer to the Standard solution method in Accuracy check on page 4.
For the best results, measure the reagent blank value for each new lot of reagent. Replace the sample with deionized water in the test procedure to determine the reagent blank value. Subtract the reagent blank value from the sample results automatically with the reagent blank adjust option.
Filter samples that are turbid with filter paper and a funnel.
Do not use the Pour-Thru Cell or sipper module (for applicable instruments) with this test.
Review the Safety Data Sheets (MSDS/SDS) for the chemicals that are used. Use the recommended personal protective equipment.
Dispose of reacted solutions according to local, state and federal regulations. Refer to the Safety Data Sheets for disposal information for unused reagents. Refer to the environmental, health and safety staff for your facility and/or local regulatory agencies for further disposal information.

Items to collect

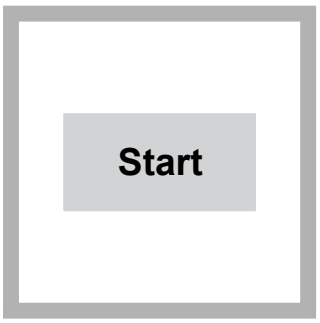
Description	Quantity
BariVer™ 4 Barium Reagent Powder Pillow	1
Sample cells (For information about sample cells, adapters or light shields, refer to Instrument-specific information on page 1.)	2

Refer to Consumables and replacement items on page 5 for order information.

Sample collection and storage

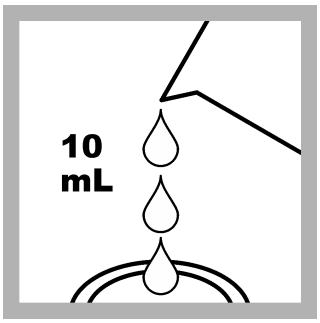
- Collect samples in clean glass or plastic bottles that have been cleaned with 6 N (1:1) hydrochloric acid and rinsed with deionized water.
- To preserve samples for later analysis, adjust the sample pH to less than 2 with concentrated nitric acid (approximately 2 mL per liter). No acid addition is necessary if the sample is tested immediately.
- Keep the preserved samples at room temperature for a maximum of 6 months.
- Before analysis, adjust the pH to 5 with 5 N sodium hydroxide solution.
- Correct the test result for the dilution caused by the volume additions.

Test procedure

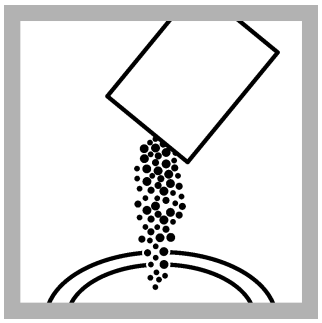


1. Start program **20 Barium**. For information about sample cells, adapters or light shields, refer to Instrument-specific information on page 1.

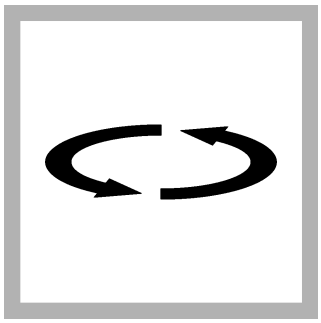
Note: *Although the program name can be different between instruments, the program number does not change.*



2. Prepare the sample: Fill a sample cell with 10 mL of sample.



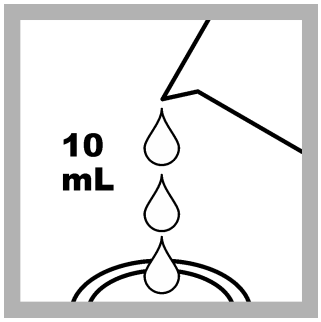
3. Add the contents of one BariVer 4 Barium Reagent Powder Pillow.



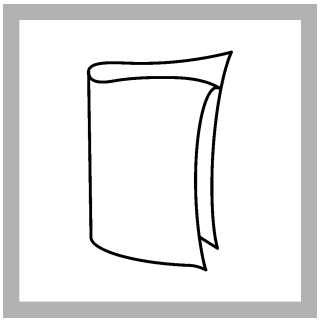
4. Swirl to mix.
The sample becomes cloudy if barium is in the sample. If the powder does not dissolve well, mix the sample and reagent in a 25-mL mixing cylinder, then pour into the sample cell.

5. Start the instrument timer. A 5-minute reaction time starts.

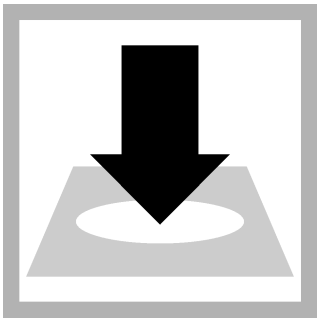
Do not move the sample cell during the reaction period.



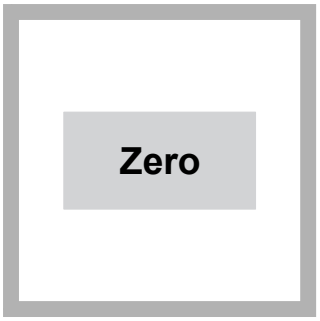
6. Prepare the blank: Fill a second sample cell with 10 mL of sample.



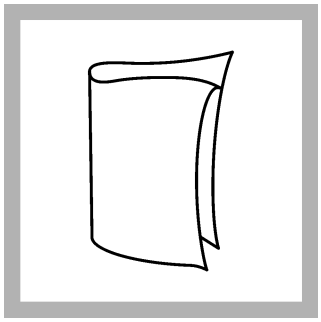
7. When the timer expires, clean the blank sample cell.



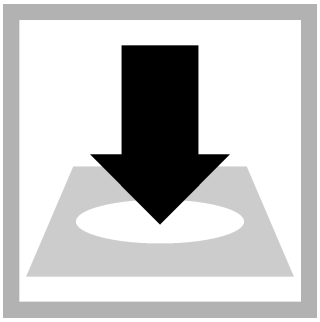
8. Insert the blank into the cell holder.



9. Push **ZERO**. The display shows 0 mg/L Ba^{2+}.

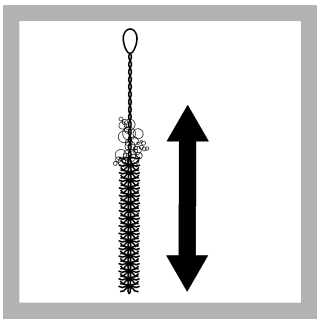


10. Clean the prepared sample cell.



11. Insert the prepared sample into the cell holder.

12. Push **READ**. Results show in mg/L Ba^{2+}.



13. Clean the sample cell immediately after each test with soap, water and a brush.

Interferences

Interfering substance	Interference level
Calcium	10,000 mg/L as $CaCO_3$
Magnesium	100,000 mg/L as $CaCO_3$
Silica	500 mg/L
Sodium Chloride	130,000 mg/L as NaCl

Interfering substance	Interference level
Strontium	The interference level is dependent on the sample matrix and the barium concentration. When the barium concentration is zero, there is no interference from strontium. The best results occur when the barium concentration is less than 20 mg/L and when the strontium concentration (as mg/L) is equal to or less than the barium concentration.
Highly buffered samples or extreme sample pH	Can prevent the pH adjustment by the reagent(s) and cause incorrect results.

Accuracy check

Standard additions method (sample spike)

Use the standard additions method (for applicable instruments) to validate the test procedure, reagents and instrument and to find if there is an interference in the sample.

Items to collect:

- Barium Standard Solution, 1000-mg/L Ba
- Pipet, TenSette, 0.1–1.0 mL
- Pipet tips

1. Use the test procedure to measure the concentration of the sample, then keep the (unspiked) sample in the instrument.
2. Go to the Standard Additions option in the instrument menu.
3. Select the values for standard concentration, sample volume and spike volumes.
4. Open the standard solution.
5. Prepare three spiked samples: use the TenSette pipet to add 0.1 mL, 0.2 mL and 0.3 mL of the standard solution, respectively, to three 10-mL portions of fresh sample. Mix well.
6. Use the test procedure to measure the concentration of each of the spiked samples. Start with the smallest sample spike. Measure each of the spiked samples in the instrument.
7. Select **Graph** to compare the expected results to the actual results.

   Note: *If the actual results are significantly different from the expected results, make sure that the sample volumes and sample spikes are measured accurately. The sample volumes and sample spikes that are used should agree with the selections in the standard additions menu. If the results are not within acceptable limits, the sample may contain an interference.*

Standard solution method

Use the standard solution method to validate the test procedure, the reagents and the instrument.

Items to collect:

- Barium Standard Solution, 1000-mg/L Ba
- 100-mL volumetric flask, Class A
- 9.00-mL volumetric pipet, Class A and pipet filler safety bulb
- Deionized water

1. Prepare a 90.0-mg/L barium standard solution as follows:
   a. Use a pipet to add 9.00 mL of 1000-mg/L barium standard solution into the volumetric flask.
   b. Dilute to the mark with deionized water. Mix well. Prepare this solution daily.
2. Use the test procedure to measure the concentration of the prepared standard solution.
3. Compare the expected result to the actual result.

   Note: *The factory calibration can be adjusted slightly with the standard adjust option so that the instrument shows the expected value of the standard solution. The adjusted calibration is then*

used for all test results. This adjustment can increase the test accuracy when there are slight variations in the reagents or instruments.

Method performance

The method performance data that follows was derived from laboratory tests that were measured on a spectrophotometer during ideal test conditions. Users can get different results under different test conditions.

Program	Standard	Precision (95% confidence interval)	Sensitivity Concentration change per 0.010 Abs change
20	30 mg/L Ba	25–35 mg/L Ba	1 mg/L Ba

Summary of method

The BariVer 4 Barium Reagent Powder combines with barium to make a barium sulfate precipitate, which is held in suspension by a protective colloid. The amount of precipitate is proportional to the barium concentration. The measurement wavelength is 450 nm for spectrophotometers or 420 nm for colorimeters.

Consumables and replacement items

Required reagents

Description	Quantity/test	Unit	Item no.
BariVer™ 4 Barium Reagent Powder Pillow	1	100/pkg	1206499

Recommended standards

Description	Unit	Item no.
Barium Standard Solution, 1000-mg/L Ba	100 mL	1461142
Water, deionized	4 L	27256

Optional reagents and apparatus

Description	Unit	Item no.
Brush, test tube	each	69000
Filter paper, 2–3-micron, pleated, 12.5-cm	100/pkg	189457
Flask, volumetric, Class A, 100-mL glass	each	1457442
Funnel, poly, 65-mm	each	108367
Liqui-Nox Phosphate-free detergent	946 mL	2088153
Nitric Acid Solution, 1:1	500 mL	254049
Paper, pH, 0–14 pH range	100/pkg	2601300
Pipet, TenSette®, 0.1–1.0 mL	each	1970001
Pipet tips for TenSette® Pipet, 0.1–1.0 mL	50/pkg	2185696
Pipet tips for TenSette® Pipet, 0.1–1.0 mL	1000/pkg	2185628
Pipet, volumetric 5.00-mL	each	1451537
Pipet filler, safety bulb	each	1465100
Sodium Hydroxide Standard Solution, 5.0 N	100 mL MDB	245032

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