

USEPA SPADNS Method¹

Method 8029
0.02 to 2.00 mg/L F⁻
Reagent Solution or AccuVac[®] Ampuls

Scope and application: For water, wastewater and seawater; USEPA accepted for reporting for drinking and wastewater analyses (distillation required).²

¹ Adapted from Standard Methods for the Examination of Water and Wastewater, 4500-F B & D.

² Procedure is equivalent to USEPA method 340.1 for drinking water and wastewater. The DR900 uses an alternative wavelength that is not within the accepted 550–580 nm range. The reagents used are the same reagents used in the USEPA accepted method.



Test preparation

Instrument-specific information

Table 1 shows sample cell and orientation requirements for reagent addition tests, such as powder pillow or bulk reagent tests. Table 2 shows sample cell and adapter requirements for AccuVac Ampul tests. The tables also show all of the instruments that have the program for this test.

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

Table 1 Instrument-specific information for reagent addition


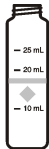
Instrument	Sample cell orientation	Sample cell
DR 6000 DR 3800 DR 2800 DR 2700 DR 1900	The fill line is to the right.	2495402 
DR 5000 DR 3900	The fill line is toward the user.	
DR 900	The fill line is toward the user.	2401906 

Table 2 Instrument-specific information for AccuVac Ampuls

Instrument	Adapter
DR 6000 DR 5000 DR 900	—
DR 3900	LZV846 (A)
DR 3800 DR 2800 DR 2700	LZV584 (C)
DR 1900	9609900 or 9609800 (C)

Before starting

Install the instrument cap on the DR 900 cell holder before ZERO or READ is pushed.

The sample and deionized water must be at the same temperature (± 1 °C). Temperature adjustments can be made before or after the reagent addition.

Make sure that the sample cells are clean and dry before the test.

Measure the volume of the reagent accurately. Use a volumetric or high precision pipet if possible.

The reagent that is used in this test is corrosive and toxic. Use protection for eyes and skin and be prepared to flush any spills with running water.

The SPADNS Reagent contains sodium arsenite. The reacted solutions must be disposed of according to local, state and federal regulations.

Minor variations between lots of reagent become measurable above 1.5 mg/L. While results above 1.5 mg/L are usable for most purposes, for the best accuracy dilute the sample to a lower concentration.

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

Reagent solution

Description	Quantity
SPADNS Reagent Solution	4 mL
Deionized water	10 mL
Pipet, volumetric, 2-mL	1
Pipet, volumetric, 10-mL	1
Pipet filler bulb	1
Sample cells (For information about sample cells, adapters or light shields, refer to Instrument-specific information on page 1.)	2
Thermometer, -10 to 110 °C	1

Refer to [Consumables and replacement items](#) on page 6 for order information.

AccuVac Ampuls

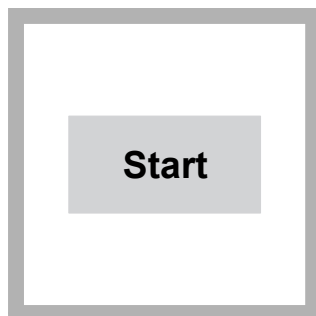
Description	Quantity
SPADNS Fluoride Reagent AccuVac [®] Ampuls	2
Deionized water	40 mL
Beaker, 50-mL	1
Stoppers for 18 mm tubes and AccuVac Ampuls	2

Refer to [Consumables and replacement items](#) on page 6 for order information.

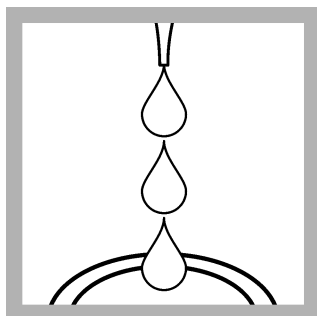
Sample collection and storage

- Collect samples in clean glass or plastic bottles.
- Samples can be kept for up to 28 days.
- Let the sample temperature increase to room temperature before analysis.

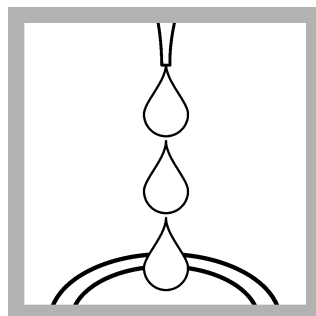
SPADNS reagent solution method



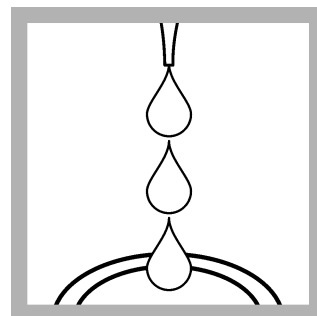
1. Start program **190 Fluoride**. For information about sample cells, adapters or light shields, refer to [Instrument-specific information](#) on page 1.



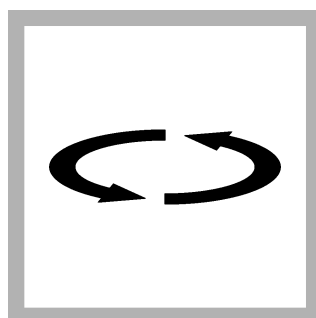
2. **Prepare the blank:** Use a pipet to add 10.0 mL of deionized water to a sample cell.



3. **Prepare the sample:** Use a pipet to add 10.0 mL of sample to a sample cell.



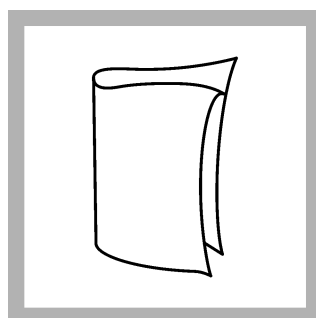
4. Use a pipet to add 2.0 mL of SPADNS Reagent Solution into each sample cell.



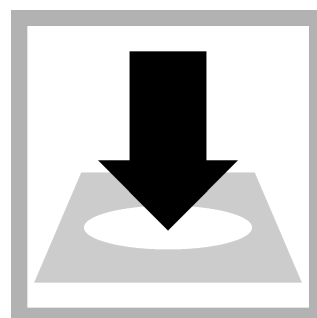
5. Swirl to mix.



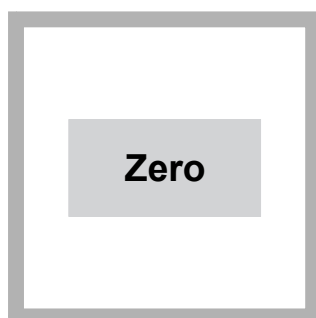
6. Start the instrument timer. A 1-minute reaction time starts.



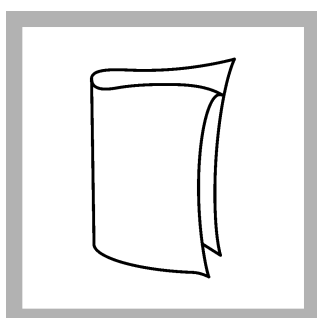
7. When the timer expires, clean the blank sample cell.



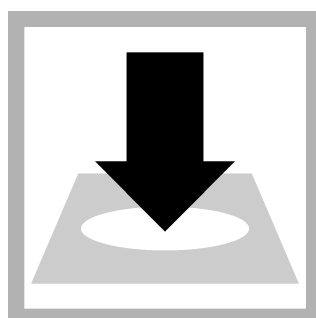
8. Insert the blank into the cell holder.



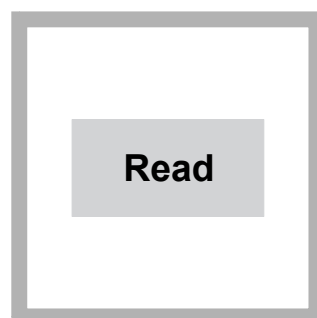
9. Push **ZERO**. The display shows 0.00 mg/L F⁻.



10. Clean the prepared sample cell.

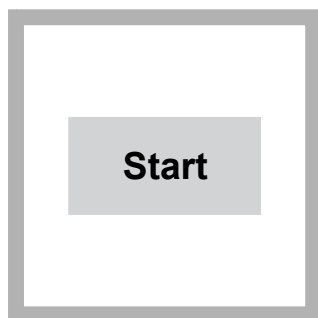


11. Insert the prepared sample into the cell holder.

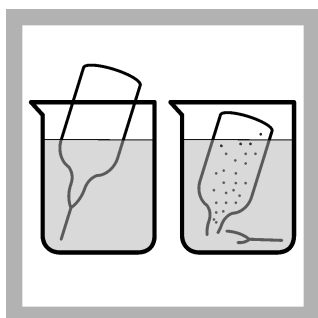


12. Push **READ**. Results show in mg/L F⁻.

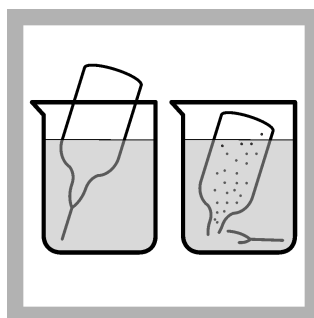
AccuVac Ampul procedure



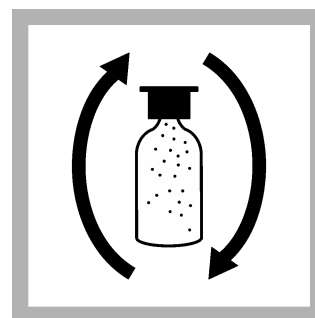
1. Start program **195 Fluoride AV**. For information about sample cells, adapters or light shields, refer to [Instrument-specific information](#) on page 1.



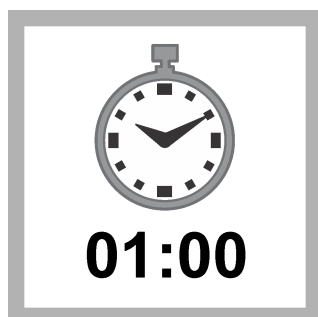
2. **Prepare the blank:** Pour at least 40 mL of deionized water in a 50-mL beaker. Fill one SPADNS Fluoride Reagent AccuVac Ampul with deionized water. Keep the tip immersed while the Ampul fills completely.



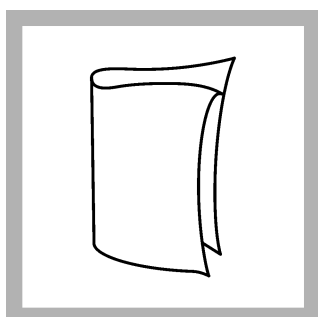
3. **Prepare the sample:** Collect at least 40 mL of sample in a 50-mL beaker. Fill the second SPADNS Fluoride Reagent AccuVac Ampul with sample. Keep the tip immersed while the Ampul fills completely.



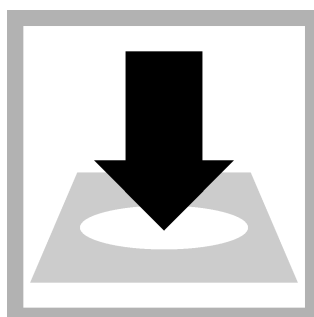
4. Quickly invert the AccuVac Ampuls several times to mix.



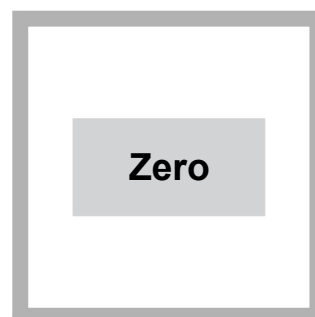
5. Start the instrument timer. A 1-minute reaction time starts.



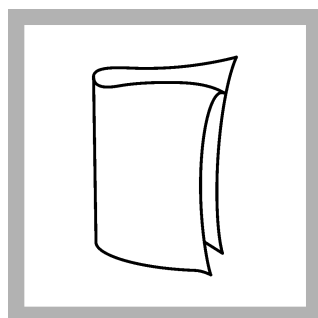
6. When the timer expires, clean the blank AccuVac Ampul.



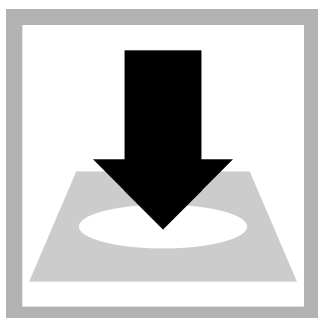
7. Insert the blank AccuVac Ampul into the cell holder.



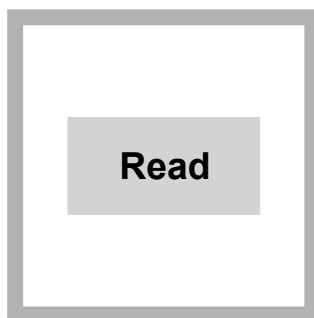
8. Push **ZERO**. The display shows 0.00 mg/L F⁻.



9. Clean the AccuVac Ampul.



10. Insert the prepared sample AccuVac Ampul into the cell holder.



11. Push **READ**. Results show in mg/L F⁻.

Interferences

This test is sensitive to small amounts of contamination. Glassware must be very clean (acid rinse before each use). Repeat the test with the same glassware to make sure that the results are accurate.

Interfering substance	Interference level
Alkalinity (as CaCO ₃)	At 5000 mg/L, it causes a -0.1 mg/L F ⁻ error.
Aluminum	At 0.1 mg/L, it causes a -0.1 mg/L F ⁻ error. To find whether there is an aluminum interference, read the concentration 1 minute after reagent addition, then again after 15 minutes. An appreciable increase in concentration suggests aluminum interference. To remove the effect of up to 3.0 mg/L aluminum, wait 2 hours, then take the final reading.
Chloride	At 7000 mg/L, it causes a +0.1 mg/L F ⁻ error.
Chlorine	SPADNS Reagent contains enough arsenite to remove up to 5 mg/L chlorine. For higher chlorine levels, add one drop of Sodium Arsenite Solution, 5.0 g/L, to 25 mL of sample to remove each additional 2 mg/L of Chlorine.
Iron, ferric	At 10 mg/L, it causes a -0.1 mg/L F ⁻ error.
Phosphate, ortho	At 16 mg/L, it causes a +0.1 mg/L F ⁻ error.
Sodium hexametaphosphate	At 1.0 mg/L, it causes a +0.1 mg/L F ⁻ error.
Sulfate	At 200 mg/L, it causes a +0.1 mg/L F ⁻ error.

Distillation

To eliminate most interferences, distill the sample, then use the distilled sample in the test procedure.

Prerequisite—prepare the distillation solution:

1. Measure 60 mL of deionized water into a 250-mL, glass Erlenmeyer flask.
2. With constant stirring, add 120 mL of concentrated sulfuric acid. **Caution: The mixture will become very hot. Put the flask in an ice bath to decrease the temperature of the solution.**

Distillation procedure:

1. Set up the distillation apparatus for general purpose distillation. Refer to the Distillation Apparatus manual for proper assembly.
2. Set up a 125-mL Erlenmeyer flask to collect the distillate.
3. Turn on the water and adjust to maintain a steady flow through the condenser.
4. Use a 100-mL graduated cylinder to add 100 mL of sample into the distillation flask.
5. Add a magnetic stir bar and 5 glass beads.
6. Set the stirrer power to on. Set the stir control to 5.
7. Use a 250-mL graduated cylinder to carefully add 150 mL of distillation solution into the flask.

Note: For samples with large amounts of chloride, add 5 mg of silver sulfate to the sample for every mg/L of chloride in the sample.

8. With the thermometer inserted, set the heat control to 10. The yellow pilot lamp is an indication that the heater is on.
9. When the temperature is 180 °C (356 °F) or when 100 mL of distillate has been collected, turn the still off (takes about 1 hour).
10. Dilute the distillate to a volume of 100 mL, if necessary. Use the diluted distillate in the test procedure.

Pollution prevention and waste management

Reacted samples contain sodium arsenite and must be disposed of as a hazardous waste. Dispose of reacted solutions according to local, state and federal regulations.

Accuracy check

Standard solution method

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

Items to collect:

- Standard solution within the test range
1. Use the test procedure to measure the concentration of the standard solution.
 2. 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 small 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
190	1.00 mg/L F ⁻	0.97–1.03 mg/L F ⁻	0.024 mg/L F ⁻
195	1.00 mg/L F ⁻	0.92–1.08 mg/L F ⁻	0.03 mg/L F ⁻

Summary of method

The SPADNS Method for fluoride determination involves the reaction of fluoride with a red zirconium-dye solution. The fluoride combines with part of the zirconium to form a colorless complex, thus bleaching the red color in an amount proportional to the fluoride concentration. This method is accepted by the EPA for NPDES and NPDWR reporting purposes when the samples have been distilled. Seawater and wastewater samples require distillation. The measurement wavelength is 580 nm for spectrophotometers or 610 nm for colorimeters.

Consumables and replacement items

Required reagents

Description	Quantity/test	Unit	Item no.
SPADNS Reagent Solution	4 mL	500 mL	44449
OR			
SPADNS Fluoride Reagent AccuVac [®] Ampuls	2	25/pkg	2506025
Water, deionized	varies	4 L	27256

Required apparatus (solution)

Description	Quantity/test	Unit	Item no.
Pipet filler, safety bulb	1	each	1465100
Pipet, volumetric, Class A, 2.00 mL	1	each	1451536
Pipet, volumetric, Class A, 10.0 mL	1	each	1451538
Sample cells, 10-mL square, matched pair	2	2/pkg	2495402
Thermometer, -10 °C to 110 °C	1	each	187701

Required apparatus (AccuVac)

Description	Quantity/test	Unit	Item no.
Beaker, 50 mL	1	each	50041H
Sample cell, 10-mL round, 25 mm x 54 mm	1	each	2122800
Sample cell, 10-mL round, 25 mm x 60 mm	1	6/pkg	2427606

Recommended standards

Description	Unit	Item no.
Fluoride Standard Solution, 0.2-mg/L F ⁻	500 mL	40502
Fluoride Standard Solution, 0.5-mg/L F ⁻	500 mL	40505
Fluoride Standard Solution, 0.8-mg/L F ⁻	500 mL	40508
Fluoride Standard Solution, 1.0-mg/L F ⁻	1000 mL	29153
Fluoride Standard Solution, 1.0-mg/L F ⁻	500 mL	29149
Fluoride Standard Solution, 1.2-mg/L F ⁻	500 mL	40512
Fluoride Standard Solution, 1.5-mg/L F ⁻	500 mL	40515
Fluoride Standard Solution, 2.0-mg/L F ⁻	500 mL	40520
Fluoride Standard Solution, 100-mg/L F ⁻	500 mL	23249
Drinking Water Standard, Mixed Parameter, Inorganic for F ⁻ , NO ₃ -N, PO ₄ ³⁻ , SO ₄ ²⁻	500 mL	2833049

Distillation reagents and apparatus

Description	Unit	Item no.
Graduated cylinder, 100 mL	each	50842
Graduated cylinder, 250 mL	each	50846
Distillation heater and support for apparatus set, 115 VAC option	each	2274400
OR		
Distillation heater and support for apparatus set, 230 VAC option	each	2274402
AND		
Distillation apparatus set, general purpose	each	2265300
Flask, Erlenmeyer, 125 mL	each	2089743
Glass beads	100/pkg	259600
Stir bar, magnetic	each	1076416
Sulfuric Acid, ACS	500 mL	97949

Optional reagents and apparatus

Description	Unit	Item no.
Silver Sulfate	113 g	33414
Sodium Arsenite, 5-g/L	100 mL	104732
AccuVac [®] Ampul Snapper	each	2405200
Wipes, disposable	280/pkg	2097000



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