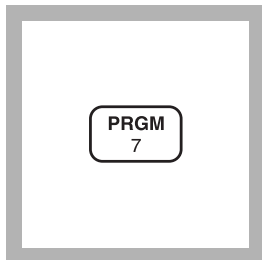


**PHOSPHORUS, REACTIVE (0 to 2.50 mg/L PO<sub>4</sub><sup>3-</sup>)** For water, wastewater, seawater**(Also called Orthophosphate) PhosVer 3 (Ascorbic Acid) Method\*****(Powder Pillows or AccuVac Ampuls)****USEPA Accepted for wastewater analysis reporting\*\*****Using Powder Pillows**

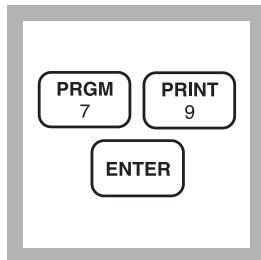
**1.** Enter the stored program number for reactive phosphorus, ascorbic acid method.

Press: **PRGM**

The display will show:

**PRGM ?**

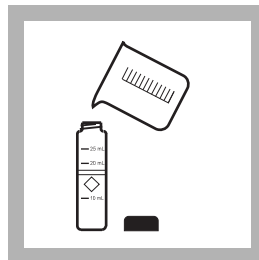
***Note:** For most accurate results, perform a Reagent Blank Correction using deionized water (see Section 1).*



**2.** Press: **79 ENTER**

The display will show **mg/L, PO<sub>4</sub>** and the **ZERO** icon.

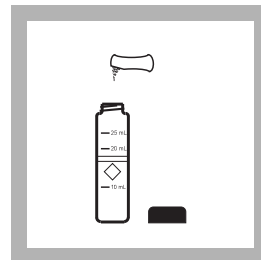
***Note:** For alternate forms (P, P<sub>2</sub>O<sub>5</sub>), press the **CONC** key.*



**3.** Fill a sample cell with 10 mL of sample.

***Note:** For samples with extreme pH, see Interferences following these steps.*

***Note:** Clean glassware with 1:1 HCl. Rinse again with deionized water. Do not use detergents containing phosphates to clean glassware.*

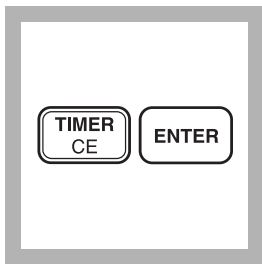


**4.** Add the contents of one PhosVer 3 Phosphate Powder Pillow for 10-mL sample to the cell (the prepared sample). Shake for 15 seconds.

***Note:** A blue color will form if phosphate is present.*

\* Adapted from *Standard Methods for the Examination of Water and Wastewater*.

\*\* Procedure is equivalent to USEPA method 365.2 and Standard Method 4500-PE for wastewater.



5. Press:

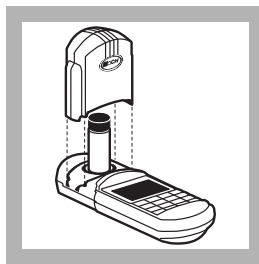
## TIMER ENTER

A two-minute reaction period will begin. Perform Steps 6-8 during this period.

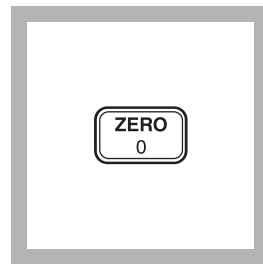
*Note: If the acid-persulfate digestion was used, an 8-10 minute reaction period is required.*



6. Fill another sample cell with 10 mL of sample (the blank).



7. Place the blank into the cell holder. Tightly cover the sample cell with the instrument cap.

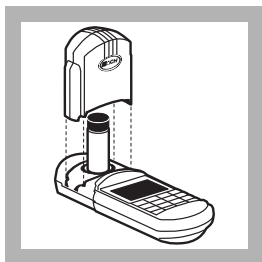


8. Press: **ZERO**

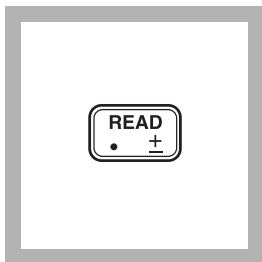
The cursor will move to the right, then the display will show:

**0.00 mg/L PO<sub>4</sub>**

*Note: If Reagent Blank Correction is on, the display may flash "limit". See Section 1.*



9. After the timer beeps, place the prepared sample into the cell holder. Tightly cover the sample cell with the instrument cap.

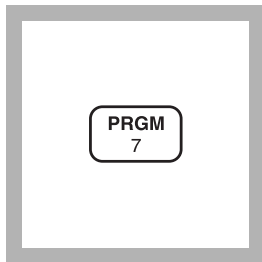


10. Press: **READ**

The cursor will move to the right, then the result in mg/L phosphate ( $\text{PO}_4^{3-}$ ) will be displayed.

*Note: Standard Adjust may be performed using a 2.0-mg/L  $\text{PO}_4^{3-}$  standard; see Section 1.*

## Using AccuVac Ampuls



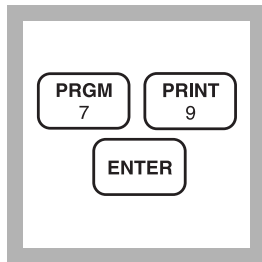
**1.** Enter the stored program number for reactive phosphorus-ascorbic acid method.

Press: **PRGM**

The display will show:

**PRGM ?**

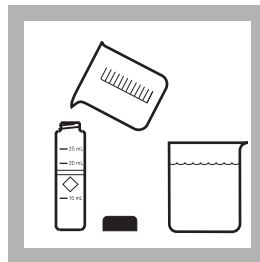
***Note:** For most accurate results, perform a Reagent Blank Correction using deionized water (see Section 1).*



**2.** Press: **79 ENTER**

The display will show **mg/L, PO<sub>4</sub>** and the **ZERO** icon.

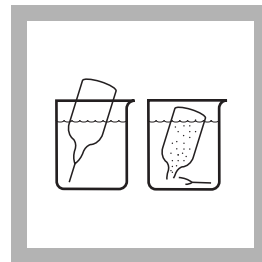
***Note:** For alternate forms (P, P<sub>2</sub>O<sub>5</sub>), press the **CONC** key.*



**3.** Fill a sample cell (the blank) with at least 10 mL of sample. Collect at least 40 mL of sample in a 50-mL beaker.

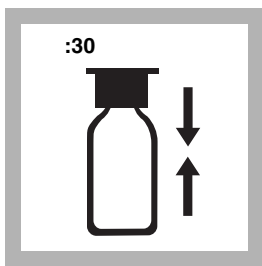
***Note:** For samples with extreme pH, see Interferences.*

***Note:** Clean glassware with 1:1 HCl. Rinse again with deionized water. Do not use detergent containing phosphates to clean glassware.*



**4.** Fill a PhosVer 3 Phosphate AccuVac Ampul with sample.

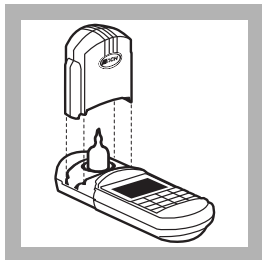
***Note:** Keep the tip immersed while the ampul fills completely.*



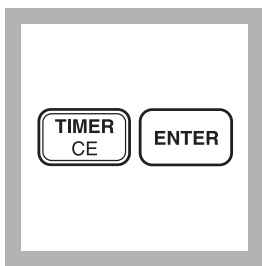
**5.** Place an ampul cap securely over the tip of the ampul. Shake the ampul for about 30 seconds. Wipe off any liquid or fingerprints.

*Note:* A blue color will form if phosphate is present.

*Note:* Accuracy is not affected by undissolved powder.



**9.** After the timer beeps, place the AccuVac ampul into the cell holder. Tightly cover the ampul with the instrument cap.

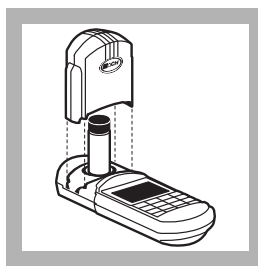


**6.** Press:

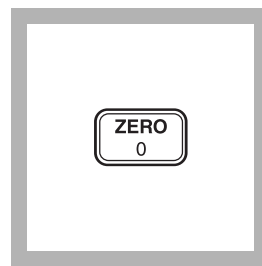
**TIMER ENTER**

A two-minute reaction period will begin. Perform Steps 7-8 during this period.

*Note:* Use an 8-10 minute reaction period if determining total phosphorus following the acid-persulfate digestion.



**7.** Place the blank into the cell holder. Tightly cover the sample cell with the instrument cap.

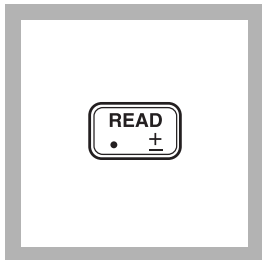


**8.** Press: **ZERO**

The cursor will move to the right, then the display will show:

**0.00 mg/L PO<sub>4</sub>**

*Note:* If Reagent Blank Correction is on, the display may flash "limit". See Section 1.



**10.** Press: **READ**

The cursor will move to the right, then the result in mg/L phosphate (PO<sub>4</sub><sup>3-</sup>) will be displayed.

*Note:* Standard Adjust may be performed using a 2.0-mg/L PO<sub>4</sub><sup>3-</sup> standard; see Section 1.

### Sampling and Storage

Collect sample in plastic or glass bottles that have been cleaned with 1:1 Hydrochloric Acid Solution and rinsed with deionized water. Do not use commercial detergents containing phosphate for cleaning glassware used in this test.

Analyze samples immediately after collection for best results. If prompt analysis is impossible, preserve samples for up to 48 hours by filtering immediately and storing samples at 4 °C. Warm to room temperature before testing.

### Accuracy Check

#### Standard Additions Method

- a) Fill three 25-mL graduated mixing cylinders with 25 mL of sample.
- b) Snap the neck off a Phosphate PourRite Ampule Standard Solution, 50 mg/L as  $\text{PO}_4^{3-}$ .
- c) Use the TenSette Pipet to add 0.1 mL, 0.2 mL, and 0.3 mL of standard, respectively, to the three mixing cylinders. Stopper each and mix thoroughly.
- d) For analysis with AccuVacs, transfer solutions to dry, clean 50 mL beakers to fill the AccuVac ampules. For analysis with powder pillows, transfer only 10 mL of solution to the sample cells.
- e) Analyze each standard addition sample as described in the procedure. The phosphate concentration should increase 0.2 mg/L  $\text{PO}_4^{3-}$  for each 0.1 mL of standard added.
- f) If these increases do not occur, see *Standard Additions* in *Section 1*.

#### Standard Solution Method

Prepare a 2.0 mg/L  $\text{PO}_4^{3-}$  standard solution by pipetting 4.0 mL of Phosphate Standard Solution, 50 mg/L as  $\text{PO}_4^{3-}$ , into an acid-washed Class A 100-mL volumetric flask. Dilute to volume with deionized water. Stopper and invert to mix. Use this solution in place of the sample in the procedure to insure the accuracy of the test. The mg/L  $\text{PO}_4^{3-}$  reading should be 2.00 mg/L.

# PHOSPHORUS, REACTIVE, continued

## Method Performance

### Precision

In a single laboratory using a standard solution of 1.00 mg/L  $\text{PO}_4^{3-}$  and two lots of reagents with the instrument, a single operator obtained a standard deviation of  $\pm 0.05$  mg/L  $\text{PO}_4^{3-}$ .

In a single laboratory using a standard solution of 1.00 mg/L  $\text{PO}_4^{3-}$  and two representative lots of AccuVac ampuls with the instrument, a single operator obtained a standard deviation of  $\pm 0.03$  mg/L  $\text{PO}_4^{3-}$ .

### Estimated Detection Limit (EDL)

The EDL for program 79 is 0.05 mg/L  $\text{PO}_4$ . For more information on the estimated detection limit, see *Section 1*.

### Interference

Interfering Substance	Interference Levels and Treatments
Aluminum	Greater than 200 mg/L
Arsenate	All levels
Chromium	Greater than 100 mg/L
Copper	Greater than 10 mg/L
Hydrogen sulfide	All levels
Iron	Greater than 100 mg/L
Nickel	Greater than 300 mg/L
Silica	Greater than 50 mg/L
Silicate	Greater than 10 mg/L
Turbidity or color	Large amounts may cause inconsistent results in the test because the acid present in the powder pillows may dissolve some of the suspended particles and because of variable desorption of orthophosphate from the particles. For highly turbid or colored samples, add the contents of one Phosphate Pretreatment Pillow to 25 mL of sample. Mix well. Use this solution to zero the instrument.
Zinc	Greater than 80 mg/L
Highly buffered samples or extreme sample pH	May exceed the buffering capacity of the reagents and require sample pretreatment. pH 2 to 10 is recommended.

### Summary of Method

Orthophosphate reacts with molybdate in an acid medium to produce a Phosphomolybdate complex. Ascorbic acid then reduces the complex, giving an intense molybdenum blue color.

# PHOSPHORUS, REACTIVE, continued

## REQUIRED REAGENTS & APPARATUS (Using Powder Pillows)

Description	Quantity Required		Unit	Cat. No.
	Per Test			
PhosVer 3 Phosphate Reagent Powder Pillows				
10 mL sample size .....	1 Pillow .....	100/pkg.....	21060-69	
Sample Cell, 10-20-25 mL, w/cap .....	2.....	6/pkg.....	24019-06	

## REQUIRED REAGENTS & APPARATUS (Using AccuVac Ampuls)

PhosVer 3 Phosphate Reagent AccuVac Ampuls....	1 ampul .....	25/pkg.....	25080-25
Beaker, 50 mL .....	1 .....	each.....	500-41
Cap, ampul, blue .....	1 .....	25/pkg.....	1731-25
Sample Cell, 10-20-25 mL, w/cap .....	1 .....	6/pkg.....	24019-06

## OPTIONAL REAGENTS

Drinking Water Standard, Inorganic, F <sup>-</sup> , NO <sub>3</sub> <sup>-N</sup> , PO <sub>4</sub> <sup>3-</sup> , SO <sub>4</sub> <sup>2-</sup> .....	500mL .....	28330-49
Hydrochloric Acid Standard Solution, 6.0 N (1:1) .....	500 mL.....	884-49
Phosphate Standard Solution, 1mg/L .....	500mL.....	2569-49
Phosphate Standard Solution, PourRite ampule,		
50 mg/L as PO <sub>4</sub> <sup>3-</sup> , 2 mL .....	20/pkg.....	171-20
Phosphate Standard Solution, Voluette Ampul, 50 mg/L, 10 mL .....	16/pkg.....	171-10
Sodium Hydroxide Standard Solution, 5.0 N .....	100 mL* MDB.....	2450-32
Wastewater Effluent Standard, Inorganic		
(NH <sub>3</sub> -N, NO <sub>3</sub> -N, PO <sub>4</sub> , COD, SO <sub>4</sub> , TOC) .....	500 mL .....	28332-49
Water, deionized .....	4 L.....	272-56

## OPTIONAL APPARATUS

AccuVac Snapper Kit .....	each.....	24052-00
Ampule Breaker Kit for 10-ml ampules.....	each.....	21968-00
Aspirator, vacuum .....	each.....	2131-00
Cylinder, graduated, mixing, 25 mL, tall (3 required) .....	each.....	20886-40
Filter Holder, 47 mm, 300 mL, graduated.....	each.....	13529-00
Filter, membrane, 47 mm, 0.45 microns .....	100/pkg.....	13530-00
Flask, filtering, 500 mL.....	each.....	546-49
Flask, volumetric, Class A, 100 mL.....	each.....	14574-42
pH Indicator Paper, 1 to 11 pH .....	5 rolls/pkg .....	391-33
pH Meter, <i>Sension</i> <sup>TM</sup> 1, portable with electrode .....	each.....	51700-10
Pipet, 2 mL serological .....	each.....	532-36
Pipet, TenSette, 0.1 to 1.0 mL TenSette Pipet.....	each.....	19700-01
Pipet Tips, for 19700-01 .....	50/pkg.....	21856-96
Pipet Tips, for 19700-01 .....	1000/pkg.....	21856-28
Pipet Filler, safety bulb .....	each.....	14651-00
Pipet, volumetric, Class A, 4.00 mL .....	each.....	14515-04
PourRite Ampule Breaker Kit .....	each.....	24846-00

Outside the U.S.A.—Contact the Hach office or distributor serving you.

\* Larger sizes available.