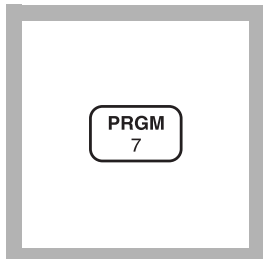


IRON, TOTAL (0 to 3.00 mg/L)

For water, wastewater, and seawater

FerroVer Method (Powder Pillows or AccuVac Ampuls)

USEPA approved for reporting wastewater analysis (digestion is required; see Section 2*)



1. Enter the stored program number for iron (Fe) powder pillows.

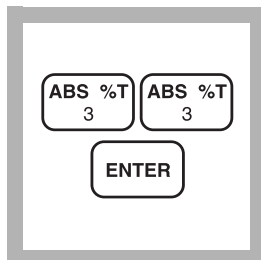
Press: **PRGM**

The display will show:

PRGM ?

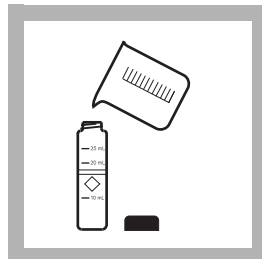
Note: Determination of total iron requires a digestion prior to analysis (see Section 2).

Note: Adjust pH of stored samples before analysis.



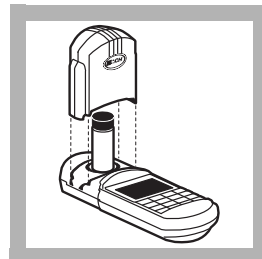
2. Press: **33 ENTER**

The display will show **mg/L, Fe** and the **ZERO** icon.

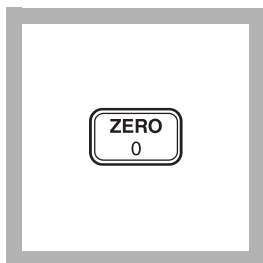


3. Fill a clean sample cell with 10 mL of sample (the blank).

Note: For turbid samples, treat the blank with one 0.1-gram scoop of RoVer Rust Remover. Swirl to mix.



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



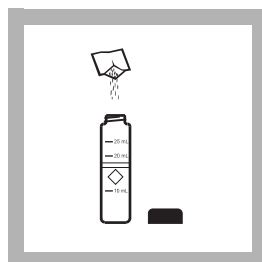
5. Press: **ZERO**

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

0.00 mg/L Fe

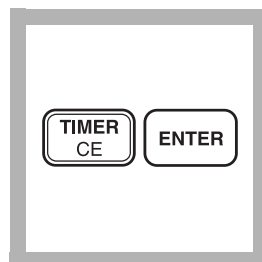


6. Fill another sample cell with 10 mL of sample.



7. Add the contents of one FerroVer Iron Reagent Powder Pillow to the sample cell (the prepared sample). Cap and invert to dissolve the reagent powder.

Note: Accuracy is not affected by undissolved powder.



8. Press:

TIMER ENTER

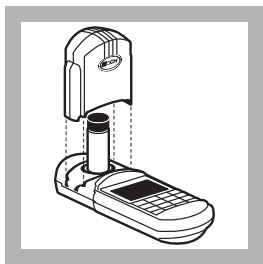
A three-minute reaction period will begin.

Note: An orange color will form if iron is present.

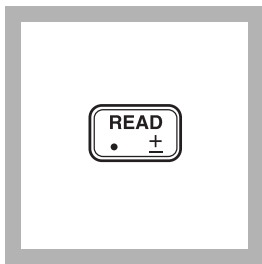
Note: Samples containing visible rust should be allowed to react at least five minutes.

* Federal Register, 45 (126) 43459 (June 27, 1980). See also 40 CFR, part 136.3, Table IB.

IRON, TOTAL, continued



9. Place the prepared sample into the cell holder. Tightly cover the sample cell with the instrument cap.

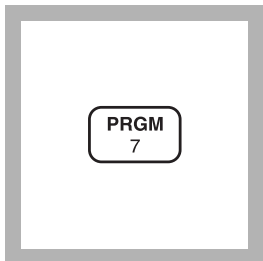


10. Press: **READ**

The cursor will move to the right, then the result in mg/L iron (Fe) will be displayed.

Note: Standard Adjust may be performed using a prepared standard (see Section 1).

Using AccuVac Ampuls



1. Enter the stored program number for iron (Fe), AccuVac ampuls.

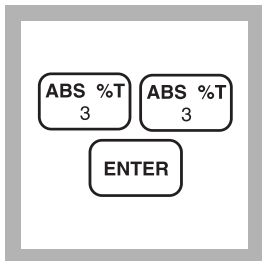
Press: **PRGM**

The display will show:

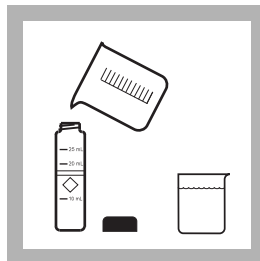
PRGM ?

Note: Adjust pH of stored samples before analysis.

Note: Determination of total iron requires a digestion prior to analysis (see Section 2).

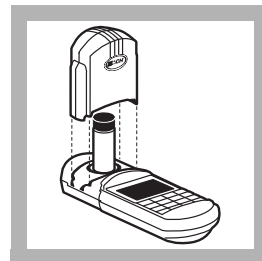


2. Press: **33 ENTER**
The display will show **mg/L, Fe** and the **ZERO** icon.



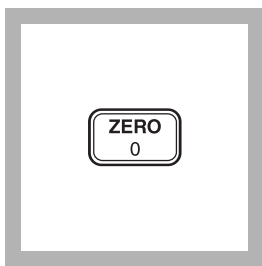
3. Fill a sample cell (the blank) with at least 10 mL of sample. Collect at least 40 mL of sample in a 50-mL beaker.

Note: For turbid samples, treat the blank with one 0.1 g scoop of RoVer Rust Remover. Swirl to mix.



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

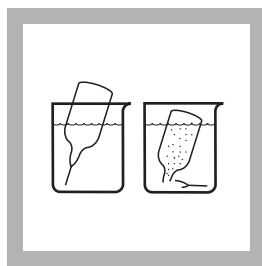
IRON, TOTAL, continued



5. Press: ZERO

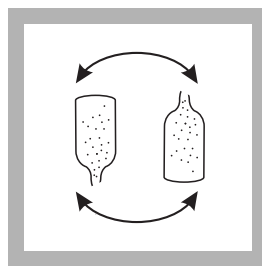
The cursor will move to the right, then the display will show:

0.00 mg/L Fe



6. Fill a FerroVer AccuVac Ampul with sample.

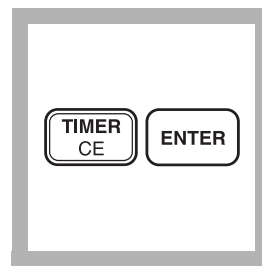
Note: Keep the tip immersed while the ampul fills completely.



7. Quickly invert the ampul several times to mix. Wipe off any liquid or fingerprints.

Note: An orange color will form if iron is present.

Note: Accuracy is not affected by undissolved powder.

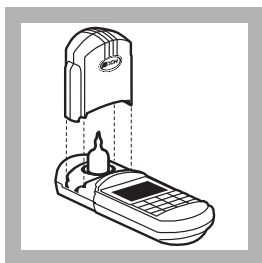


8. Press:

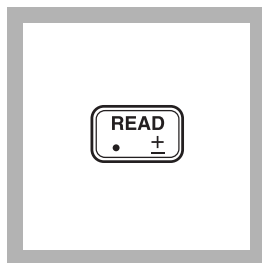
TIMER ENTER

A three-minute reaction period will begin.

Note: Samples containing visible rust should be allowed to react at least five minutes.



9. Place the AccuVac ampul into the cell holder. Tightly cover the ampul with the instrument cap.



10. Press: READ

The cursor will move to the right, then the result in mg/L iron (Fe) will be displayed.

Note: Standard Adjust may be performed using a prepared standard (see Section 1).

IRON, TOTAL, continued

Sampling and Storage

Collect samples in acid-cleaned glass or plastic containers. No acid addition is necessary if analyzing the sample immediately. To preserve samples, adjust the pH to 2 or less with nitric acid (about 2 mL per liter). Preserved samples may be stored up to six months at room temperature. Adjust the pH to between 3 and 5 with 5.0 N Sodium Hydroxide Standard Solution before analysis. Correct the test result for volume additions; see *Correcting for Volume Additions* in *Section 1* for more information. If only dissolved iron is to be determined, filter the sample before adding the acid.

Accuracy Check

Standard Additions Method

- a) Snap the neck off a 50 mg/L Iron PourRite Ampule Standard Solution.
- b) Use the TenSette Pipet to add 0.1, 0.2, and 0.3 mL of standard, respectively, to three 25-mL samples and mix thoroughly.
- c) For analysis using AccuVac Ampuls, transfer solutions to dry, clean 50-mL beakers to facilitate filling of the ampuls. For analysis with powder pillows, transfer only 10 mL of solution to the 10-mL sample cells.
- d) Analyze each standard addition sample as described above. The iron concentration should increase 0.2 mg/L for each 0.1 mL of standard added.
- e) If these increases do not occur, see *Standard Additions* in *Section 1* for troubleshooting information.

Standard Solution Method

Prepare a 1.0-mg/L iron standard by diluting 1.00 mL of Iron Standard Solution, 100 mg/L Fe, to 100 mL with deionized water. Or, dilute 1.00 mL of an Iron PourRite Ampule Standard Solution (50 mg/L) to 50 mL in a volumetric flask. Prepare this solution daily.

Run the test following the procedure for powder pillows or AccuVac Ampuls. Results should be between 0.90 mg/L and 1.10 mg/L Fe.

IRON, TOTAL, continued

Method Performance

Precision

In a single laboratory, using a standard solution of 2.00 mg/L Fe and two representative lots of powder pillow reagents with the instrument, a single operator obtained a standard deviation of ± 0.017 mg/L.

In a single laboratory, using a standard solution of 2.00 mg/L Fe and two representative lots of AccuVac ampuls with the instrument, a single operator obtained a standard deviation of ± 0.009 mg/L Fe.

Estimated Detection Limit (EDL)

The EDL for program 33 is 0.03 mg/L Fe. For more information on derivation and use of Hach's estimated detection limit, see *Section 1*.

Interferences

Interfering Substances and Suggested Treatments

Interfering Substance	Interference Level and Treatment
Calcium, Ca^{2+}	No effect at less than 10,000 mg/L as CaCO_3
Chloride, Cl^-	No effect at less than 185,000 mg/L.
Copper, Cu^{2+}	No effect. Masking agent is contained in FerroVer Iron Reagent.
High Iron Levels	Inhibits color development. Dilute sample and retest to verify results.
Iron Oxide	Requires mild, vigorous or Digesdahl digestion (see Section 2). After digestion, adjust sample to pH 3-5 with sodium hydroxide, then analyze.
Magnesium	No effect at 100,000 mg/L as CaCO_3 .
Molybdate, Molybdenum	No effect at 25 mg/L as Mo.
High Sulfide Levels, S^{2-}	<ol style="list-style-type: none">1. Treat in fume hood or well-ventilated area. Add 5 mL HCl to 100 mL sample in a 250-mL Erlenmeyer flask. Boil 20 minutes.2. Cool. Adjust pH to 3-5 with NaOH. Re-adjust volume to 100 mL with deionized water.3. Analyze.

IRON, TOTAL, continued

Interfering Substance	Interference Level and Treatment
Turbidity	<ol style="list-style-type: none"> 1. Add 0.1 g scoop of RoVer Rust Remover to the blank in Step 3. Swirl to mix. 2. Zero the instrument with this blank. 3. If sample remains turbid, add three 0.2 g scoops of RoVer to a 75-mL sample. Let stand 5 minutes. 4. Filter through a glass filter or centrifuge. 5. Use filtered sample in Steps 3 and 6.
Sample pH (extreme)	Adjust pH to 3-5. See <i>Interferences</i> in <i>Section 1</i> .
Highly Buffered Samples	Adjust pH to 3-5. See <i>Interferences</i> in <i>Section 1</i> .

Summary of Method

FerroVer Iron Reagent reacts with all soluble iron and most insoluble forms of iron in the sample to produce soluble ferrous iron. This reacts with 1,10-phenanthroline indicator in the reagent to form an orange color in proportion to the iron concentration.

REQUIRED REAGENTS & APPARATUS (Using Powder Pillows)

Description	Quantity Required Per Test	Unit	Cat No.
FerroVer Iron Reagent Powder Pillows	1 pillow	100/pkg.....	21057-69
Sample cell, 10-20-25 mL, with screw cap	1	6/pkg.....	24019-06

REQUIRED REAGENTS & APPARATUS (Using AccuVac Ampuls)

FerroVer Iron Reagent AccuVac Ampuls	1 ampul	25/pkg.....	25070-25
Beaker, 50 mL.....	1	each.....	500-41H

OPTIONAL REAGENTS

Description	Unit	Cat. No.
Ammonium Hydroxide, ACS	500 mL.....	106-49
Drinking Water Standard, Metals, LR (Cu, Fe, Mn)	500 mL.....	28337-49
Drinking Water Standard, Metals, HR (Cu, Fe, Mn).....	500 mL.....	28336-49
Hydrochloric Acid Standard Solution, 6 N.....	500 mL.....	884-49
Hydrochloric Acid, ACS.....	500 mL.....	134-49
Iron Standard Solution, 100 mg/L	100 mL.....	14175-42
Iron Ampule Standard, 50 mg/L	20/pkg.....	14254-20
Nitric Acid, ACS.....	500 mL.....	152-49
Nitric Acid Solution, 1:1	500 mL.....	2540-49
RoVer Rust Remover	454 g.....	300-01
Sodium Hydroxide Standard Solution, 5.0 N	100 mL MDB.....	2450-32
Water, deionized.....	4 L.....	272-56

IRON, TOTAL, continued

OPTIONAL APPARATUS

AccuVac Snapper Kit	each	24052-00
Ampule Breaker, PourRite Ampules.....	each	24846-00
Clippers, Shears 7 ¹ / ₄ ".....	each	23694-00
Cylinder, graduated, poly, 25 mL.....	each	1081-40
Cylinder, graduated, poly, 100 mL.....	each	1081-42
Digesdahl Digestion Apparatus, 115 V	each	23130-20
Digesdahl Digestion Apparatus, 230 V.....	each	23130-21
Filter Discs, glass, 47 mm	100/pkg	2530-00
Filter Holder, membrane	each	2340-00
Filter Pump.....	each	2131-00
Flask, Erlenmeyer, 250 mL	each	505-46
Flask, filtering, 500 mL.....	each	546-49
Flask, volumetric, Class A, 50 mL.....	each	14574-41
Flask, volumetric, Class A, 100 mL.....	each	14574-42
Hot Plate, 4" diameter, 120 VAC	each	12067-01
Hot Plate, 4" diameter, 240 VAC	each	12067-02
pH Meter, <i>sensio</i> TM <i>n</i> 1, portable, with electrode.....	each	51700-10
pH Indicator Paper, 1 to 11 pH.....	each	391-33
Pipet Filler, safety bulb	each	14651-00
Pipet, serological, 2 mL.....	each	532-36
Pipet, serological, 5 mL.....	each	532-37
Pipet, TenSette, 0.1 to 1.0 mL.....	each	19700-01
Pipet Tips, for 19700-01 TenSette Pipet	50/pkg	21856-96
Pipet Tips, for 19700-01 TenSette Pipet	1000/pkg	21856-28
Pipet, volumetric, Class A, 1.00 mL	each	14515-35
Spoon, measuring, 0.1 g.....	each	511-00

For Technical Assistance, Price and Ordering

In the U.S.A.—Call 800-227-4224

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