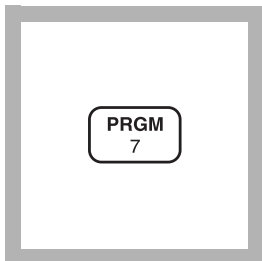


**MANGANESE, High Range (0 to 20.0 mg/L)**

For water and wastewater

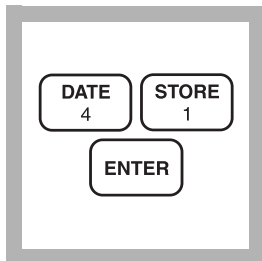
**Periodate Oxidation Method\* USEPA approved for reporting wastewater analysis (digestion is required; see Section 2)\*\***

**1.** Enter the stored program number for manganese, periodate oxidation method.

Press: **PRGM**

The display will show:

**PRGM ?**



**2.** Press: **41 ENTER**

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

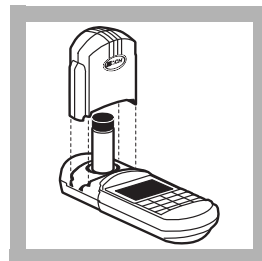
*Note:* For alternate forms ( $KMnO_4$ ,  $MnO_4$ ), press the **CONC** key.



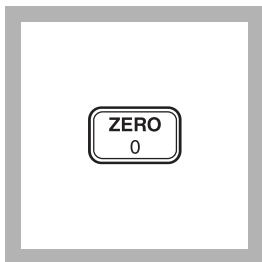
**3.** Fill a sample cell with 10 mL of sample (the blank).

*Note:* For total manganese determination perform a digestion (see Section 2).

*Note:* Adjust the pH of stored samples before analysis.



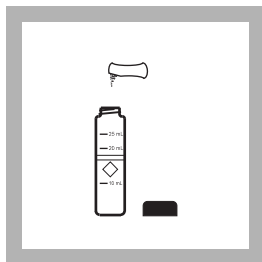
**4.** Place the blank into the cell holder. Tightly cover the sample cell with the instrument cap.



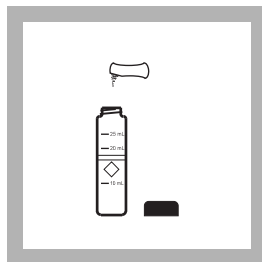
**5.** Press: **ZERO**

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

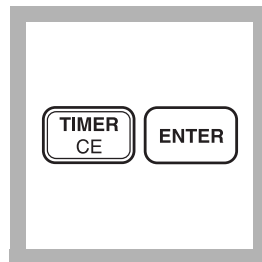
**0.0 mg/L Mn**



**6.** Remove the cell from the instrument. Add the contents of one Buffer Powder Pillow, citrate type, to the cell. Cap the cell and invert until the powder is dissolved. Remove cap.



**7.** Add the contents of one Sodium Periodate Powder Pillow to the sample cell (the prepared sample). Cap the sample cell. Invert for 10 seconds to mix.



**8.** Press: **TIMER ENTER**

A two-minute reaction period will begin.

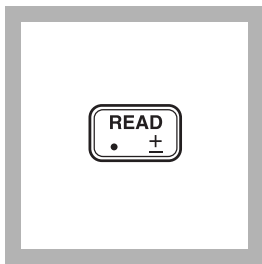
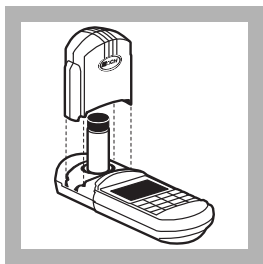
*Note:* A violet color will form if manganese is present.

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

\*\* *Federal Register*, 44 (116) 34193 (June 14, 1979).

## MANGANESE, High Range, continued

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**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 manganese will be displayed.

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

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### Sampling and Storage

Collect samples in acid-washed plastic bottles. Manganese may be lost by adsorption to glass container walls. Adjust the pH to less than 2 with nitric acid (about 2 mL per liter). Preserved samples may be stored up to six months at room temperature. Adjust the pH to 4 to 5 with 5.0 N sodium hydroxide before analysis. Do not exceed pH 5, as manganese may be lost as a precipitate. Correct the test result for volume additions; see *Correction for Volume Additions* in Section 1 for more information. If only dissolved Mn is to be determined, filter before acid addition.

### Accuracy Check

#### Standard Additions Method

- a) Snap the neck off a Manganese Voluette Ampule Standard Solution, 250 mg/L Mn.
- b) Use the TenSette Pipet to add 0.1, 0.2 and 0.3 mL of standard, respectively, to the three 25-mL water samples. Swirl to mix.
- c) Transfer only 10 mL of each solution to the 10-mL sample cells.
- d) Analyze each standard addition sample as described in the procedure. The manganese concentration should increase 1.0 mg/L for each 0.1 mL of standard added.

## MANGANESE, High Range, continued

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- e) If these increases do not occur, see *Standard Additions* in *Section 1* for troubleshooting information.

### Standard Solution Method

Prepare a 5.0 mg/L manganese standard solution by pipetting (use a TenSette or Class A volumetric pipet) 5.00 mL of Manganese Standard Solution, 1000 mg/L Mn, into a 1000-mL volumetric flask. Dilute to the mark with deionized water. Or, prepare this standard by diluting 1.00 mL of a High Range Manganese Standard Volute Ampule, 250 mg/L, to 50 mL. Prepare these solutions daily. Use these solutions as the sample in the procedure.

### Method Performance

#### Precision

In a single laboratory, using a standard solution of 10.00 mg/L Mn and two representative lots of reagent with the instrument, a single operator obtained a standard deviation of  $\pm 0.18$  mg/L Mn.

#### Estimated Detection Limit

The estimated detection limit for program 41 is 0.2 mg/L Mn. For more information on the estimated detection limit, see *Section 1*.

### Interferences

The following may interfere when present in concentrations exceeding those listed below:

Calcium	700 mg/L
Chloride	70,000 mg/L
Iron	5 mg/L
Magnesium	100,000 mg/L

Highly buffered samples or extreme sample pH may exceed the buffering capacity of the reagents and require sample pretreatment; see *pH Interferences* in *Section 1*.

### Summary of Method

Manganese in the sample is oxidized to the purple permanganate state by sodium periodate, after buffering the sample with citrate. The purple color is directly proportional to the manganese concentration.

# MANGANESE, High Range, continued

## REQUIRED REAGENTS

High Range Manganese Reagent Set (100 tests) 10 mL .....			<b>Cat. No.</b>
			24300-00
Includes: (1) 21076-69, (1) 21077-69			

Description	Quantity Required		Cat. No.
	Per Test	Unit	
Buffer Powder Pillows, citrate type for Manganese .....	1 pillow.....	100/pkg.....	21076-69
Sodium Periodate Powder Pillows for Manganese.....	1 pillow.....	100/pkg.....	21077-69

## REQUIRED APPARATUS

Sample Cell, 10-20-25 mL, w/cap.....	2 .....	6/pkg.....	24019-06
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## OPTIONAL REAGENTS

Drinking Water Standard, Metals, HR (Cu, Fe, Mn) .....	500 mL.....	28336-49
Hydrochloric Acid, 6 N .....	500 mL.....	884-49
Manganese Standard Solution, 1000 mg/L Mn .....	100 mL.....	12791-42
Manganese Standard Solution, Voluette ampule, High Range, 250 mg/L Mn, 10 mL .....	16/pkg.....	14258-10
Nitric Acid, ACS.....	500 mL.....	152-49
Nitric Acid Solution 1:1.....	500 mL.....	2540-49
Sodium Hydroxide Solution, 5.0 N .....	100 mL MDB.....	2450-32
Water, deionized.....	4 L.....	272-56

## OPTIONAL APPARATUS

Ampule Breaker Kit.....	each.....	21968-00
Flask, Erlenmeyer, 250 mL.....	each.....	505-46
Flask, volumetric, Class A, 50 mL .....	each.....	14574-41
Flask, volumetric, Class A, 100 mL .....	each.....	14574-42
Flask, volumetric, Class A, 1000 mL .....	each.....	14574-53
pH Indicator Paper, 1 to 11 pH .....	5 rolls/pkg.....	391-33
pH Meter, <i>sension</i> <sup>TM</sup> I, portable, with electrode .....	each.....	51700-10
Pipet, serological, 5 mL .....	each.....	532-37
Pipet, TenSette, 0.1 to 1.0 mL.....	each.....	19700-01
Pipet, TenSette, 1.0 to 10.0 mL.....	each.....	19700-10
Pipet Tips, for 19700-01 TenSette Pipet .....	50/pkg..	21856-96
Pipet Tips, for 19700-01 TenSette Pipet .....	1000/pkg.....	21856-28
Pipet Tips, for 19700-10 TenSette Pipet .....	50/pkg.....	21997-96
Pipet, volumetric, Class A, 5.00 mL.....	each.....	14515-37
Pipet, volumetric, Class A, 1.00 mL.....	each.....	14515-35
Pipet Filler, safety bulb .....	each.....	14651-00

### *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.