

# Hardness Total 4

Range(s): 0-4.00 ppm CaCO<sub>3</sub>



## Procedure

Note: Glassware that has not been properly cleaned may contaminate the sample and affect test results. Clean glassware thoroughly before use with phosphate-free detergent (available at local stores); then rinse with Hydrochloric Acid 3N (R-0737) followed by DI Water (R-0833) or sample water.

1. Turn on the Colorimeter.
2. Select a test menu (ALL TESTS, RECENT TESTS, or FAVORITES) containing Hardness Calcium 4 using ◀▶.
3. Select Hardness Calcium 4 using ▲▼; then press ENTER ⊙.
4. Verify the chemical form selected for expression of test results is CaCO<sub>3</sub>.
5. Rinse and fill 25 mm sample cell to 20 mL mark with sample.
6. Add 0.5 mL Hardness Total 4 - Reagent A.
7. Add 0.5 mL Hardness Total 4 - Reagent B; then cap and swirl to mix thoroughly.
8. Insert sample cell into sample cell compartment. Align marks per User's Manual.

9. Select ZERO using ◀▶; then press ENTER ⊙. Zero will be displayed.
10. Remove sample cell from sample cell compartment; then remove cap.
11. Add 2 drops Hardness Total 4 - Reagent C; then cap and swirl to mix thoroughly.
12. Insert sample cell into sample cell compartment. Align marks.
13. Wait approximately 10 seconds before proceeding to next step.
14. Select READ using ◀▶; then press ENTER ⊙. The instrument will read the sample and the result will be displayed.
15. **Record value as calcium hardness.** (Leave sample cell in sample cell compartment.)
16. Select NEW using ◀▶; then press ENTER ⊙.
17. Select a test menu (ALL TESTS, RECENT TESTS, or FAVORITES) containing Hardness Magnesium 4 using ◀▶.
18. Select Hardness Magnesium 4 using ▲▼; then press ENTER ⊙.

19. Select ZERO using ◀▶; then press ENTER ⊙. Zero will be displayed.
20. Remove sample cell from sample cell compartment; then remove cap.
21. Add 2 drops Hardness Total 4 - Reagent D; then cap and swirl to mix thoroughly.
22. Insert sample cell into sample cell compartment. Align marks.
23. Wait approximately 10 seconds before proceeding to next step.
24. Select READ using ◀▶; then press ENTER ⊙. The instrument will read the sample and the result will be displayed.
25. **Record value as magnesium hardness.**
26. To calculate total hardness: total hardness = calcium hardness + magnesium hardness
27. Record value as total hardness.

Note: For calcium hardness > 1.20 ppm as CaCO<sub>3</sub> or total hardness > 2.00 as CaCO<sub>3</sub>, dilute sample with DI Water (R-0833) and repeat test.

## Instruction #5088

### Interferences

Copper > 0.75 ppm – negative interference  
EDTA or EGTA, all levels – negative interference

To remove interference: Rinse cells thoroughly before use.

Iron, Ferric > 1.4 ppm – negative interference for calcium and magnesium hardness

Iron, Ferrous > 1.4 ppm – negative interference for calcium and magnesium hardness

Manganese > 0.4 ppm – positive interference for calcium hardness

Zinc > 0.15 ppm – negative interference for calcium hardness and positive interference for magnesium hardness

The following analytes were tested to the levels listed and found not to cause any interference up to the specified values:

Alkalinity, Total (CaCO<sub>3</sub>) – 50 ppm

Chlorine – 4 ppm

Chromate – 0.5 ppm

### Test Method

Calmagite

In a strongly alkaline solution, the indicator calmagite reacts with free calcium and magnesium to produce a red color. The chelating agent EGTA is added to destroy any red color due to calcium, and the corresponding change in absorbance is proportional to calcium hardness. The chelating agent EDTA is added to destroy any red color due to magnesium, and the corresponding change in absorbance is proportional to magnesium hardness. Once all hardness has been chelated, the sample will have a purplish-blue color.

Calcium Hardness + Magnesium Hardness = Total Hardness

### Estimated Detection Limit

0.04 ppm calcium hardness as CaCO<sub>3</sub>

0.01 ppm magnesium hardness as CaCO<sub>3</sub>

0.05 ppm total hardness as CaCO<sub>3</sub>

### Precision

Using a single lot of each reagent and a standard solution of 2.0 ppm total hardness (1.0 ppm magnesium + 1.0 ppm calcium), an individual analyst obtained a standard deviation with the instrument of ± 0.02 ppm calcium hardness as CaCO<sub>3</sub>, 0.01 ppm magnesium hardness as CaCO<sub>3</sub>, and 0.03 ppm total hardness as CaCO<sub>3</sub>.

### Application

Industrial Water Systems – This method is best suited for testing water treated by an ion exchange resin or membrane filter. Testing samples with higher levels of hardness will require sample dilution.

### Ordering Info

#### Reagent Pack

K-8022 Hardness Total 4

Formulated for exclusive use with Taylor's TTI® Colorimeter.

#### Reagent Pack Components

R-8022A Hardness Total 4 - Reagent A

R-8022B Hardness Total 4 - Reagent B

R-8022C Hardness Total 4 - Reagent C

R-8022D Hardness Total 4 - Reagent D

#### Optional Reagents & Accessories

R-0737 Hydrochloric Acid 3N

R-0833 DI Water



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