

# Hardness, Calcium/Magnesium

DOC316.53.01528

**Metal Phthalein Colorimetric Method****Method 10293****20 to 350 mg/L CaCO<sub>3</sub>, 5 to 100 mg/L Ca or 3 to 50 mg/L Mg****TNTplus® 869**

**Scope and application:** For raw (untreated) water, drinking water, surface water, boiler water and process control.



## Test preparation

### Instrument-specific information

Table 1 shows all of the instruments that have the program for this test. The table also shows the adapter and light shield requirements for the applicable instruments that can use TNTplus vials.

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

**Table 1 Instrument-specific information for TNTplus vials**

Instrument	Adapters	Light shield
DR 6000, DR 5000	—	—
DR 3900	—	LZV849
DR 3800, DR 2800	—	LZV646
DR 1900	9609900 or 9609800 (A)	—

### Before starting

DR 3900, DR 3800, DR 2800: Install the light shield in Cell Compartment #2 before this test is started.

Review the safety information and the expiration date on the package.

The sample pH must be 4–9 for accurate results.

The temperature of the samples and reagents must be 15–25 °C (59–77 °F) for accurate results.

The recommended temperature for reagent storage is 15–25 °C (59–77 °F).

To determine magnesium in samples with a very low magnesium concentration and a high calcium concentration, use the TNTplus 849 Magnesium procedure.

DR 1900: Go to All Programs>LCK or TNTplus Methods>Options to select the TNTplus number for the test. Other instruments automatically select the method from the barcode on the vial.

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.

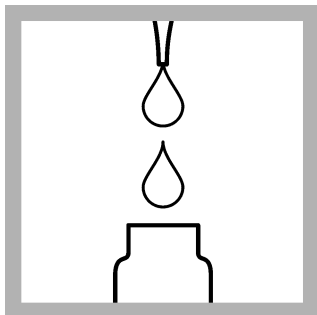
### Items to collect

Description	Quantity
Water Hardness TNTplus Reagent Set	1
Pipet, adjustable volume, 1.0–5.0 mL	1
Pipet, adjustable volume, 0.2–1.0 mL	1
Pipet tips	3

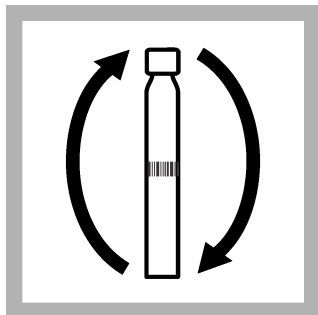
## Sample collection

- Collect samples in clean glass or plastic bottles with tight-fitting caps. Completely fill the bottle and immediately tighten the cap.
- Prevent agitation of the sample and exposure to air.
- Analyze the samples as soon as possible for best results.
- If immediate analysis is not possible, keep the samples at or below 6 °C (43 °F) for a maximum of 24 hours.
- Let the sample temperature increase to room temperature before analysis.

## Test procedure—Total hardness



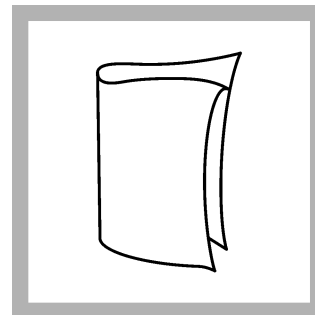
1. Use a pipet to add 4.0 mL of Solution A to the test vial.



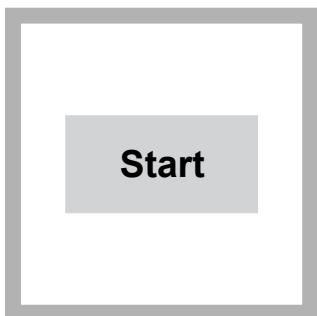
2. Tighten the cap on the vial and invert until completely mixed.



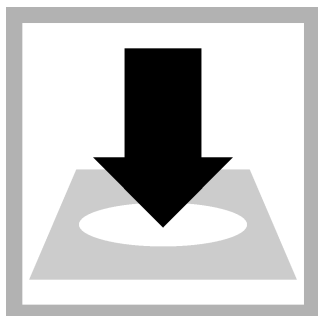
3. Start the reaction time of 2 minutes.



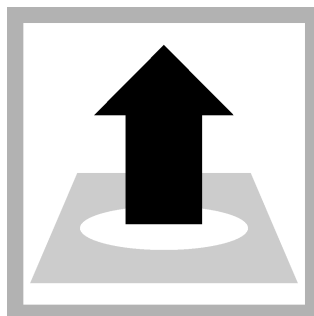
4. When the timer expires, clean the vial.



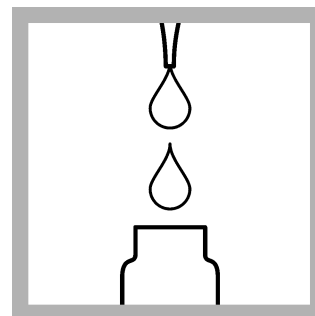
5. DR 1900 only: Select program 869. Refer to [Before starting](#) on page 1.



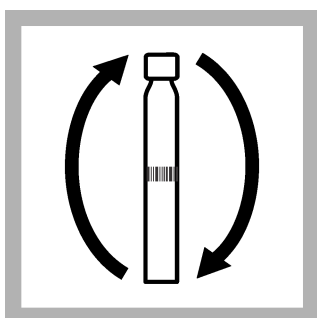
6. Insert the vial into the cell holder. DR 1900 only: Push **READ 1**. The instrument zero is set.



7. Remove the vial.



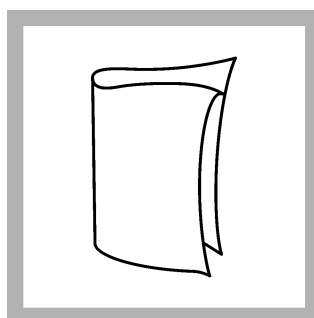
8. Use a pipet to add 0.2 mL of sample to the test vial.



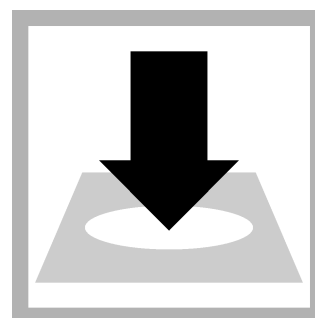
9. Tighten the cap on the vial and invert the vial 2–3 times.



10. Start the reaction time of 30 seconds.

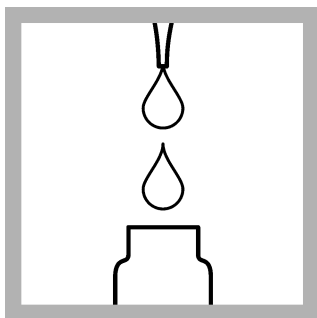


11. When the timer expires, clean the vial.

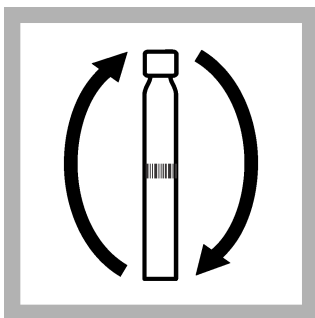


12. Insert the vial into the cell holder. DR 1900 only: Push **READ 2**. The total hardness result shows in mg/L CaCO<sub>3</sub>.

## Test procedure—Total, calcium and magnesium hardness



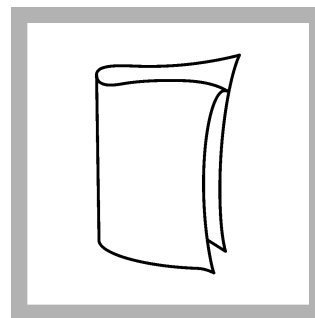
1. Use a pipet to add 4.0 mL of Solution A to the test vial.



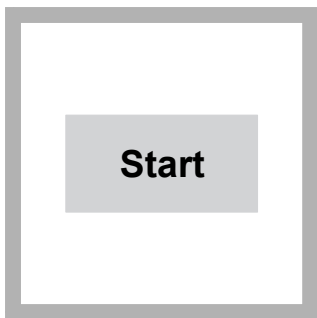
2. Tighten the cap on the vial and invert until completely mixed.



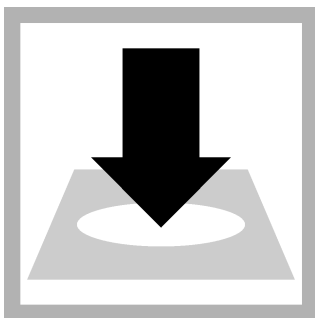
3. Start the reaction time of 2 minutes.



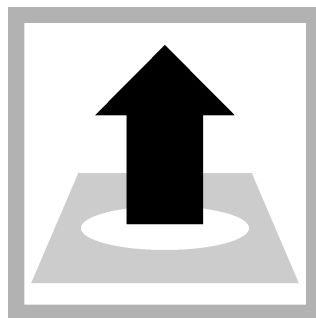
4. When the timer expires, clean the vial.



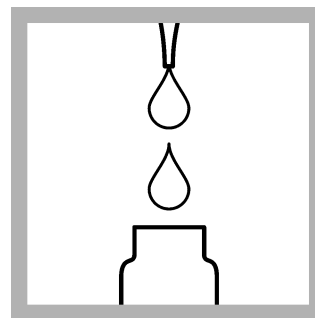
5. DR 1900 only: Select program 869. Refer to [Before starting](#) on page 1.



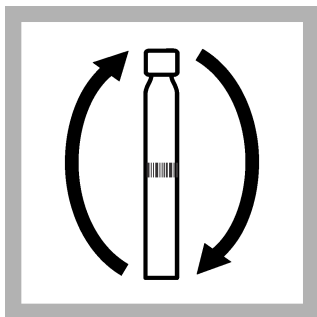
6. Insert the vial into the cell holder. DR 1900 only: Push **READ 1**. The instrument zero is set.



7. Remove the vial.



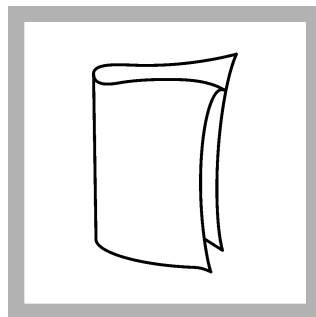
8. Use a pipet to add 0.2 mL of sample to the test vial.



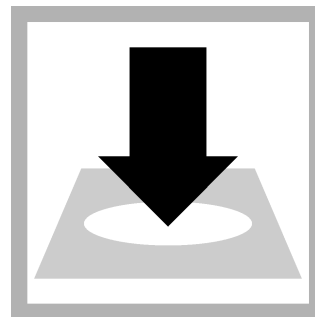
9. Tighten the cap on the vial and invert the vial 2–3 times.



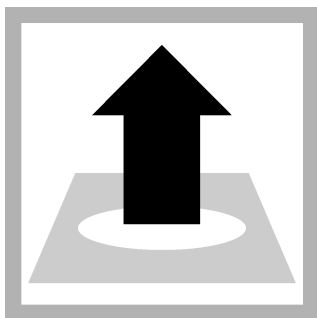
10. Start the reaction time of 30 seconds.



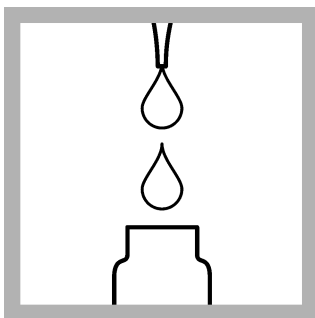
11. When the timer expires, clean the vial.



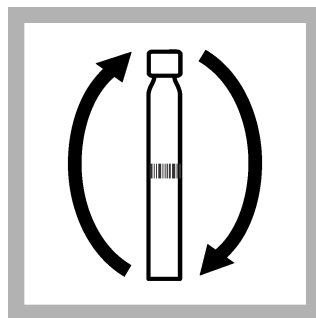
12. Insert the vial into the cell holder. DR 1900 only: Push **READ 2**.



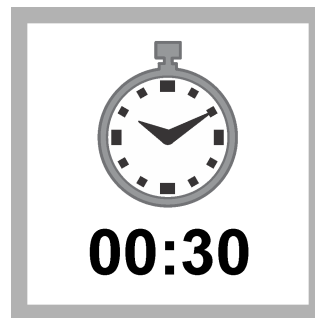
13. Remove the vial.



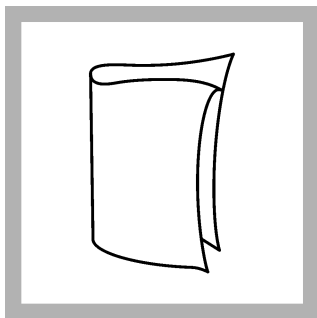
14. Use a pipet to add 0.2 mL of Solution B to the test vial.



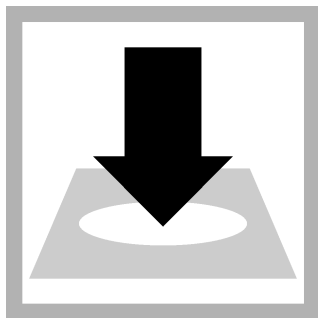
15. Tighten the cap on the vial and invert the vial 2–3 times.



16. Start the reaction time of 30 seconds.



17. When the timer expires, clean the vial.



18. Insert the vial into the cell holder. DR 1900 only: Push **READ 3**. Results show:  
Calcium: mg/L Ca,  
Magnesium: mg/L Mg, Total  
Hardness: mg/L CaCO<sub>3</sub>.

## Interferences

There are no known interferences for drinking water and boiler water samples.

To validate the test results, dilute the sample with a known volume of deionized water. Use the diluted sample in the test procedure and multiply the result by the dilution factor. As an alternative, spike the sample with a standard solution and compare the expected result to the actual result.

## Accuracy check

### Standard solution method

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

Items to collect:

- 100-mg/L (as Ca) Calcium Standard Solution
1. Use the test procedure to measure the concentration of the standard solution.
  2. Compare the expected result to the actual result.

**Note:** 100 mg/L calcium as Ca is equivalent to 250 mg/L hardness as CaCO<sub>3</sub>.

## Summary of Method

Calcium and magnesium ions react with metal phthalein to give a violet dye. The measurement wavelength is 572 nm.

## Consumables and replacement items

### Required reagents

Description	Quantity/Test	Unit	Item no.
Water Hardness TNTplus Reagent Set	1	25/pkg	TNT869

### Required apparatus

Description	Quantity/test	Unit	Item no.
Pipet, adjustable volume, 1.0–5.0 mL	1	each	BBP065
Pipet tips, for 1.0–5.0 mL pipet	1	75/pkg	BBP068
Pipet, adjustable volume, 0.2–1.0 mL	1	each	BBP078
Pipet tips, for 0.2–1.0 mL pipet	2	100/pkg	BBP079

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**Required apparatus (continued)**

Description	Quantity/test	Unit	Item no.
Light shield, DR 3900	1	each	LZV849
Light shield, DR 3800, DR 2800, DR 2700	1	each	LZV646

**Recommended standards**

Description	Unit	Item no.
Calcium standard solution, 100 mg/L Ca	500 mL	4457649



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