Manganese LR PAN (50)

DOC316.53.01517

1-(2-Pyridylazo)-2-Naphthol PAN Method[1] **Method 10286**

0.005 to 0.500 mg/L Mn **HPT291**

Scope and application: For drinking water, mineral water, raw water and process analysis. Sample digestion is necessary for total manganese determinations.

[1] Adapted from Goto, K., et al., Talanta, 24, 652-3 (1977).

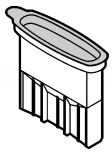
Test preparation

Instrument-specific information

Table 1 shows all of the instruments that have the program for this test. The table also shows requirements that can change between instruments, such as adapter and sample cell requirements.

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

Table 1 Instrument-specific information

Instrument	Adapter	Sample cell orientation	50-mm sample cell
DR 6000	LZV902.99.00020	The thin side is to the right.	LZP341 
DR 5000	A23618	The thin side is toward the user.	
DR 3900, DR3800, DR 2800, DR 2700	—	The thin side is to the right.	

Before starting

To make sure that all forms of the metal are measured, digest the sample with heat and acid. Use the mild or vigorous digestion. Refer to the *Water Analysis Guide* for more information.
Clean all glassware with 1:1 nitric acid, then rinse with deionized water to remove contaminants.
The temperature of the samples and reagents must be 15–25 °C (59–77 °F) for accurate results.
The reagents contain cyanide. Make sure to read the Safety Data Sheets and obey the safety precautions.
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

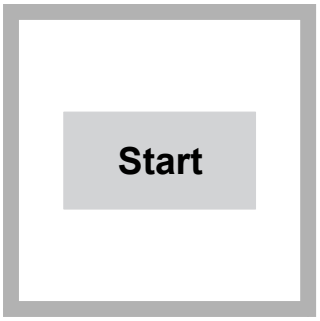
Description	Quantity
Manganese HPT291 Reagent Set	1
Beaker, 50 mL	1
Pipet, adjustable volume, 0.2–1.0 mL	1
Pipet, adjustable volume, 1.0–5.0 mL or Pipet, TenSette®, 1.0–10.0 mL	1
Pipet tips	1

Refer to Consumables and replacement items on page 4 for order information.

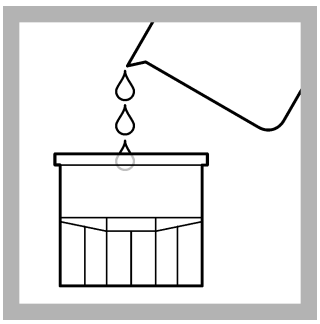
Sample collection and storage

- Collect samples in clean glass or plastic bottles that have been cleaned with 6 N (1:1) hydrochloric acid and rinsed with deionized water.
- To preserve samples for later analysis, adjust the sample pH to less than 2 with concentrated nitric acid (approximately 2 mL per liter). No acid addition is necessary if the sample is tested immediately.
- Keep the preserved samples at room temperature for a maximum of 6 months.
- Before analysis, adjust the pH to 3–10 with 5 N sodium hydroxide solution.
- Correct the test result for the dilution caused by the volume additions.

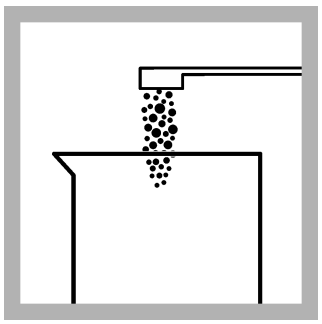
Test procedure



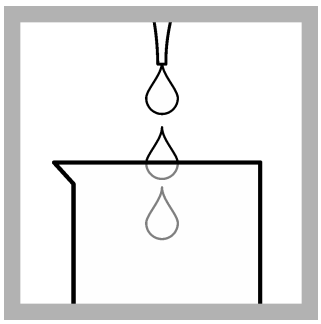
1. Start **Program 291 Manganese LR PAN 50**. For information about sample cells, adapters or light shields, refer to Instrument-specific information on page 1.



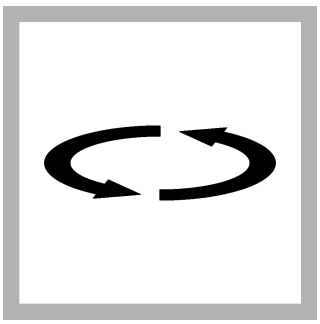
2. Blank Preparation: Fill a 50-mm sample cell with sample. Tap the sample cell to remove air bubbles.



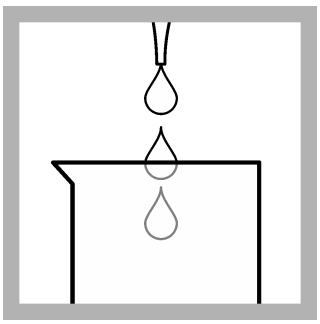
3. Prepared Sample: Add one level spoonful of Reagent A into a beaker.



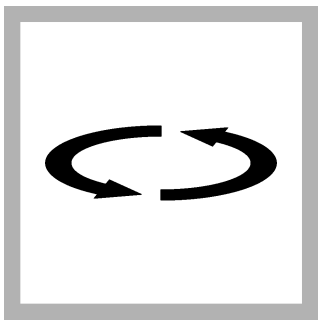
4. Use a pipet to add 10.0 mL of sample.



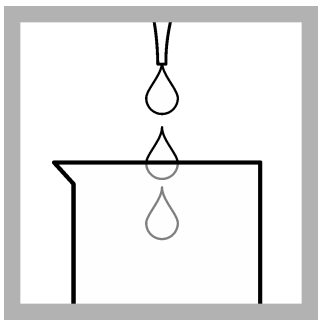
5. Swirl to mix until the reagent is fully dissolved.



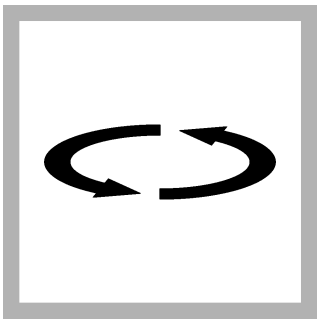
6. Use a pipet to add 1.0 mL of Reagent B.



7. Swirl to mix.

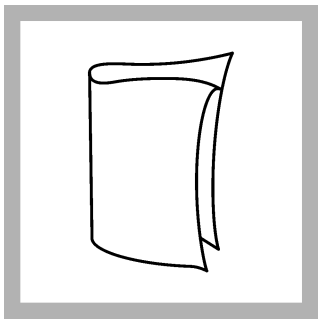


8. Immediately add 1.0 mL of Reagent C.

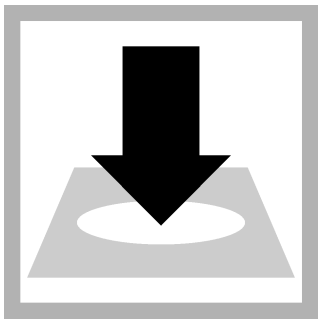


9. Swirl to mix.
The sample will show an orange color if manganese is present.

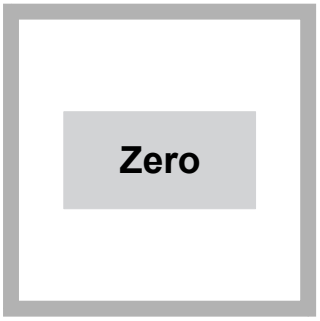
10. Start the instrument timer. A 2-minute reaction time starts.



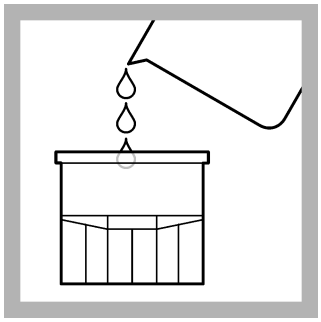
11. When the timer expires, clean the blank sample cell.



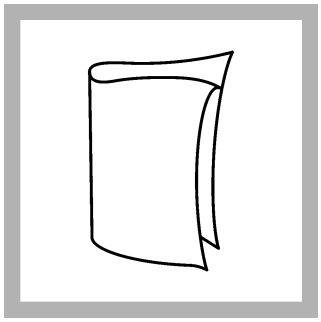
12. Insert the blank into the cell holder.



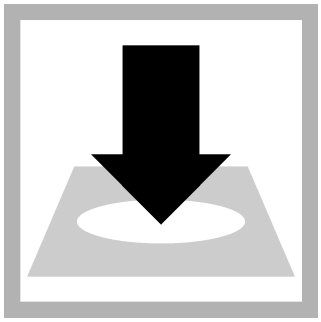
13. Push **ZERO**. The display shows 0.000 mg/L Mn.



14. Pour the prepared sample into a second sample cell. Tap the sample cell to remove air bubbles.



15. Clean the prepared sample cell.



16. Insert the prepared sample into the cell holder.

17. Push **READ**. Results show in mg/L Mn.

Interferences

Verify the measurement results with sample dilutions or standard additions to determine the possibility of an interference. Table 2 shows the substances that were tested for interference and do not interfere at or below the levels that are shown.

Table 2 Interference table

Interfering substance	Interference level
Aluminum Al^{3+}	20 mg/L
Cadmium Cd^{2+}	2.5 mg/L
Calcium Ca^{2+}	500 mg/L
Chloride Cl^{-}	1000 mg/L
Chromium Cr^{6+}	2.5 mg/L
Chromium Cr^{3+}	0.5 mg/L
Cobalt Co^{2+}	20 mg/L
Copper Cu^{2+}	50 mg/L
Iron Fe^{2+}, Fe^{3+}	10 mg/L
Lead Pb^{2+}	0.5 mg/L
Magnesium Mg^{2+}	100 mg/L as Mg^{2+}
Nickel Ni^{2+}	50 mg/L
Nitrate NO_3^{-}	50 mg/L
Sulfate SO_4^{2-}	1000 mg/L
Zinc Zn^{2+}	2.5 mg/L

Accuracy check

Standard solution method

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

Items to collect:

- Manganese Standard Solution, 25 mg/L Mn
- 100-mL volumetric flask, Class A
- 1.0-mL volumetric pipet, Class A and pipet filler safety bulb
- Deionized water

1. Prepare a 0.25 mg/L-manganese standard solution as follows:
   a. Use a pipet to add 1.0 mL of the 25-mg/L manganese standard solution into the volumetric flask.
   b. Dilute to the mark with deionized water. Mix well. Prepare this solution daily.
2. Use the test procedure to measure the concentration of the prepared standard solution.
3. Compare the expected result to the actual result.

Summary of Method

The PAN method is a highly sensitive and rapid procedure to measure low levels of manganese. The ascorbic acid reagent reduces all oxidized forms of manganese to Mn^{2+}. The alkaline-cyanide reagent masks potential interferences. PAN Indicator then forms an orange-colored complex with Mn^{2+}. The measurement wavelength is 560 nm.

Consumables and replacement items

Required reagents

Description	Quantity/Test	Unit	Item no.
Manganese HPT291 Reagent Set	1	25/pkg	HPT291

Required apparatus

Description	Quantity/test	Unit	Item no.
Cuvette, semi-micro, 5-cm	varies	10/pkg	LZP341
Beaker, 50 mL	1	each	50041H
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

Recommended standards

Description	Unit	Item no.
Manganese Standard Solution, 10-mg/L Mn, 2 mL PourRite® Ampule	20/pkg	2605820
Manganese Standard Solution, 2-mL PourRite® Ampule, 25 mg/L	20/pkg	2112820
Metals Drinking Water Standard, LR for Cu, Fe, Mn	500 mL	2833749

Optional reagents and apparatus

Description	Unit	Item no.
Ampule Breaker, 2-mL PourRite® Ampules	each	2484600
Flask, volumetric, Class A, 100 mL, glass	each	1457442
Nitric Acid, concentrated	500 mL	15249
Pipet filler, safety bulb	each	1465100
Pipet, TenSette®, 0.1–1.0 mL	each	1970001
Pipet, TenSette®, 1.0–10.0 mL	each	1970010
Pipet tips for TenSette® Pipet, 0.1–1.0 mL	50/pkg	2185696
Pipet tips for TenSette® Pipet, 1.0–10.0 mL	50/pkg	2199796
Pipet, volumetric, Class A, 1.00 mL	each	1451535
Sodium Hydroxide Standard Solution, 5.0 N	100 mL MDB	245032

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