

# STANDARD OPERATING PROCEDURE

For

SM 2340 B (SM 23<sup>d</sup> Edition)

Hardness by Calculation

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SOP #: SM 2340 B

SOP REVISION #: 2.0

DATE: July 2022

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## MassDEP

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## LIST OF REVISIONS

Rev. #	Date	Description of Revision	Section #
0	March 2005	None (Based on LIMS WinLab32 via LIMSLink)	
1.0	November 2009	Significant changes throughout document (Based on Sample Master LIMS)	
2.0	July 2022	Significant changes throughout document (Based on WinLIMS)	



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## **1.0 SCOPE AND APPLICATION**

- 1.1 Hardness by calculation is applicable to all waters. Metals analysis by ICP-OES of magnesium (Mg) and calcium (Ca) on water samples yields the concentration in mg/L of Ca and Mg to be used in the calculation of hardness.

## **2.0 SUMMARY OF METHOD**

- 2.1 Hardness (Total or Dissolved) is calculated from results of separate determinations of calcium and magnesium by EPA Method 200.7 (Total or Dissolved).

## **3.0 DEFINITIONS**

- 3.1 See DELS SOP for U.S. EPA Method 200.7.
- 3.2 The hardness MRL is calculated from the lowest addend of the hardness calculation. The purpose of the hardness MRL is to clearly show the lowest possible hardness concentration that could be reported given the associated EPA Method 200.7 MRLs for calcium and magnesium. A hardness result of < MRL means that the EPA Method 200.7 calcium and magnesium results were both < MRL.

## **4.0 INTERFERENCES**

- 4.1 See DELS SOP for U.S. EPA Method 200.7.

## **5.0 SAFETY**

- 5.1 See DELS SOP for U.S. EPA Method 200.7.

## **6.0 EQUIPMENT AND SUPPLIES**

- 6.1 See WINLIMS and DELS SOP for U.S. EPA Method 200.7.

## **7.0 REAGENTS AND STANDARDS**

- 7.1 See DELS SOP for U.S. EPA Method 200.7.

## **8.0 SAMPLE COLLECTION, PRESERVATION AND STORAGE**

- 8.1 See DELS SOP for U.S. EPA Method 200.7.

## **9.0 QUALITY CONTROL**

- 9.1 See DELS SOP for U.S. EPA Method 200.7.

## **10.0 CALIBRATION**

- 10.1 See DELS SOP for U.S. EPA Method 200.7.

## **11.0 PROCEDURE**

- 11.1 Analyze water samples for Ca and Mg by ICP-OES (See DELS SOP for U.S. EPA Method 200.7).



## 12.0 DATA ANALYSIS AND CALCULATIONS

12.1 Enter Ca and Mg analytical results for EPA Method 200.7 into WinLIMS. The hardness calculation has been programmed into WinLIMS.

12.2 The calculation for hardness is from Standard Methods:<sup>(15.1)</sup>

$$\text{Hardness, mg equivalent CaCO}_3/\text{L} = 2.49 (\text{Ca, mg/L}) + 4.118 (\text{Mg, mg/L})$$

12.3 To enter the data, two Worklist (WL) batches must be created, one for Metals by EPA Method 200.7 and one for Hardness by SM 2340 B. Both WL batches must include the same samples being analyzed for Hardness.

If Dissolved Hardness is being analyzed, the samples must be analyzed for Metals, Dissolved by EPA Method 200.7.

If Total Hardness is being analyzed, the samples must be analyzed for Metals, Total by EPA Method 200.7.

Create the WL batch for Metals by EPA Method 200.7.

- For each field sample, prune away any analytes that are not being used. At a minimum, the analytes Ca, Mg, and Y must remain; all other analytes requested by the client may remain and be carried through the normal workflow.

Create the WL batch for Hardness by SM 2340 B.

- Select the same unknown samples as are recorded in the EPA Method 200.7 WL batch.

12.4 In the EPA Method 200.7 worklist, enter the result values, dilution factors, and target values where applicable, then save. If Calcium or Magnesium have dilution factors (DF) other than 1, enter those values on both the concentration rows and the calculation rows.

12.5 In the Hardness worklist, select all samples and open the results page.

- Select all result rows and hit recalculate (calculator icon). This populates the Hardness worklist with the raw EPA Method 200.7 analytical results.
- Select all result rows and hit calculate **again**. This triggers the Hardness calculation function.

If any of the results on the EPA Method 200.7 subsequently need to be corrected:

- Enter those changes, save, recalculate, and save again.
- Return to the Hardness WL results page, select all, recalculate (to update the linked data) and save; then repeat select all/recalculate (to trigger the Hardness calculation function to recalculate the results) and save.

12.6 In the Hardness WL comment field, add the following text: *The Hardness MRL is calculated from the lower EPA Method 200.7 Ca or Mg MRLs on each sample. A Hardness result of < MRL means that the EPA Method 200.7 Ca and Mg results were both < MRL.*

12.7 Default Hardness MRL: Hardness is calculated for any reportable results for Ca or Mg by EPA Method 200.7. Reportable results are numeric values that are equal to or greater than the EPA Method 200.7 MRL for each analyte. The Default Hardness MRL is the



lowest possible reportable hardness result, which is a function of the lowest EPA Method 200.7 MRL for Ca or Mg being used in the Hardness equation shown in Section 12.2.

For example: If the EPA Method 200.7 MRLs are 0.1 mg/L for Ca, and 0.03 mg/L for Mg, then Mg has the lowest MRL and is the basis of the calculated Hardness MRL. Therefore, the Hardness MRL calculation becomes:  $4.118 \times \text{Mg MRL (mg/L)} = 4.118 \times 0.03 \text{ mg/L} = 0.12 \text{ mg/L}$ .

The Default Hardness MRL will be updated every time there is a change in the EPA Method 200.7 MRLs for Ca or Mg.

- 12.8 Calculated Hardness MRL: WinLIMS calculates the adjusted Hardness MRL by using the values for the DF-adjusted MRLs from EPA Method 200.7 in the Hardness calculation equation as shown in Section 12.2. If the calculated Hardness MRL exceeds the default Hardness MRL, WinLIMS reports the lowest calculated value. If the MRL does not exceed the default MRL, WinLIMS reports the default MRL.

### 13.0 POLLUTION PREVENTION

- 13.1 Refer to the WES Environmental Management System (EMS) policy and SOPs regarding pollution prevention.
- 13.2 The quantity of chemicals purchased should be based on expected usage during its shelf life. Actual reagent preparation volumes should reflect anticipated usage and reagent stability.

### 14.0 WASTE MANAGEMENT

- 14.1 WES laboratories fully comply with all applicable federal, state, and local environmental regulations. WES is also committed to protecting the air, water, and land by minimizing and controlling all chemical releases from fume hoods, biological safety cabinets, and bench operations. Refer to the WES EMS policy and SOPs regarding waste management.
- 14.2 All waste chemicals are collected in sealed waste containers. Once the waste containers reach capacity, they are transferred to the WES hazardous waste storage room where they are emptied into a waste drum (organic or inorganic). Within 180-days of waste accumulation, the waste drum is transported off the premises by a licensed hazardous waste management contractor. Under the WES EMS, a chemical inventory database has been developed to track purchases and use of chemicals and other hazardous materials, and the waste generated by the use of these chemicals.

### 15.0 REFERENCES

- 15.1 *Standard Methods for the Examination of Water and Wastewater*, 23<sup>rd</sup> Edition, 2017. Standard Method 2340 B. American Public Health Association, American Water Works Association, and Water Environment Federation, Washington, DC.

### 16.0 TABLES

**For QC Criteria, see DELS-WES U.S. EPA Method 200.7 SOP, Rev. 4.4., Table 1.**