



# Standard Guide for Water Analysis for Electrodialysis/Electrodialysis Reversal Applications<sup>1</sup>

This standard is issued under the fixed designation D 5091; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

## 1. Scope

1.1 This guide covers the determinations that should be performed on any given water if processing by electrodialysis/electrodialysis reversal is being considered.

1.2 This guide is applicable to all waters but is not necessarily complete for wastewaters.

1.3 This is a guide only and should not be construed as a complete delineation of all analysis required for a specific application.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

## 2. Referenced Documents

### 2.1 ASTM Standards:

- D 511 Test Methods for Calcium and Magnesium in Water<sup>2</sup>
- D 512 Test Methods for Chloride Ion in Water (Method B)<sup>2</sup>
- D 516 Test Method for Sulfate Ion in Water<sup>2</sup>
- D 857 Test Methods for Aluminum in Water<sup>2</sup>
- D 1067 Test Methods for Acidity or Alkalinity of Water<sup>2</sup>
- D 858 Test Methods for Manganese in Water<sup>2</sup>
- D 1068 Test Methods for Iron in Water (Method C or D)<sup>2</sup>
- D 1125 Test Methods for Electrical Conductivity and Resistivity of Water<sup>2</sup>
- D 1129 Terminology Relating to Water<sup>2</sup>
- D 1179 Test Methods for Fluoride Ion in Water<sup>2</sup>
- D 1253 Test Method for Residual Chlorine in Water<sup>2</sup>
- D 1293 Test Methods for pH of Water<sup>2</sup>
- D 1889 Test Method for Turbidity of Water<sup>2</sup>
- D 2579 Test Methods for Total and Organic Carbon in Water<sup>3</sup>
- D 3352 Test Methods for Strontium Ion in Brackish Water, Seawater, and Brines<sup>3</sup>
- D 3370 Practices for Sampling Water from Closed Conduits<sup>2</sup>

D 3561 Test Method for Lithium, Potassium and Sodium Ions in Brackish Water, Seawater, and Brines by Atomic Absorption Spectrophotometry<sup>3</sup>

D 3867 Test Methods for Nitrite-Nitrate in Water<sup>2</sup>

D 3920 Test Method for Strontium in Water<sup>2</sup>

D 4189 Test Method for Silt Density Index (SDI) of Water<sup>2</sup>

D 4191 Test Method for Sodium in Water by Atomic Absorption Spectrophotometry<sup>2</sup>

D 4192 Test Method for Potassium in Water by Atomic Absorption Spectrophotometry<sup>2</sup>

D 4327 Test Method for Anions in Water by Chemically Suppressed Ion Chromatography<sup>2</sup>

D 4382 Test Method for Barium in Water, Atomic Absorption Spectrophotometry, Graphite Furnace<sup>2</sup>

D 4658 Test Method for Sulfide Ion in Water<sup>2</sup>

D 4839 Test Method for Total Carbon and Organic Carbon in Water by Ultraviolet, or Persulfate Oxidation, or Both, and Infrared Detection<sup>3</sup>

2.2 *American Public Health Association Standards: Standard Methods for the Examination of Water and Wastewater, Eighteenth Edition, 1992, pp. 4-123 to 4-128<sup>4</sup>*

## 3. Terminology

3.1 *Definitions*—For definitions of terms used in this guide, refer to Terminology D 1129.

## 4. Summary of Guide

4.1 This guide consists of recommended water analyses for ions, gases, suspended materials, organics, temperature, and pH for potential applications of electrodialysis/electrodialysis reversal.

## 5. Significance and Use

5.1 The design of an electrodialysis/electrodialysis reversal system is determined by the composition of the feedwater and the desired composition of the product water. The determinations and measurements performed in this guide will provide the necessary information for making design projections of staging and power consumption.

5.2 The recovery at which an electrodialysis/electrodialysis reversal system can be safely operated is dependent on the

<sup>1</sup> This guide is under the jurisdiction of ASTM Committee D-19 on Water and is the direct responsibility of Subcommittee D19.08 on Membranes and Ion Exchange Materials.

Current edition approved Sept. 10, 1995. Published November 1995. Originally published as D 5091 – 90. Last previous edition D 5091 – 90.

<sup>2</sup> *Annual Book of ASTM Standards*, Vol 11.01.

<sup>3</sup> *Annual Book of ASTM Standards*, Vol 11.02.

<sup>4</sup> Available from the American Public Health Association, 1015 Fifteenth Street, N.W., Washington, DC 20005.

composition of the feed solution. The determinations measurements performed in this guide will provide data for the calculation of the maximum recovery of a system utilizing a specific feed water.

5.3 The determinations and measurements performed in this guide will be valuable for determining needed pretreatment for meeting specific product water requirements with the specific feed water.

## 6. Procedure

6.1 Collect a sample of the water to be tested in accordance with Practices D 3370.

6.2 Determine the concentration of:

Sodium—Test Methods D 3561, D 4191	(Na <sup>+</sup> )
Calcium—Test Methods D 511	(Ca <sup>++</sup> )
Magnesium—Test Methods D 511	(Mg <sup>++</sup> )
Potassium—Test Methods D 3561, D 4192	(K <sup>+</sup> )
Chloride—Test Methods D 512, D 4327	(Cl <sup>-</sup> )
Bicarbonate—Test Methods D 1067	(HCO <sub>3</sub> <sup>-</sup> )
Carbonate—Test Methods D 1067	(CO <sub>3</sub> <sup>-</sup> )
Sulfate—Test Methods D 516, D 4327	(SO <sub>4</sub> <sup>-</sup> )
Nitrate—Test Methods D 3867, D 4327	(NO <sub>3</sub> <sup>-</sup> )
Manganese—Test Methods D 858	(Mn) Total and Dissolved
Iron—Test Methods D 1068	(Fe) Total and Dissolved
Aluminum—Test Methods D 857	(Al)
Barium—Test Methods D 4382	(Ba <sup>++</sup> )
Strontium—Test Methods D 3352, D 3920	(Sr <sup>++</sup> )
Fluoride—Test Methods D 1179	(F <sup>-</sup> )

The results may be expressed as (a) milligrams per litre (mg/L) as the ion; (b) milligrams per litre (mg/L) as calcium carbonate; or (c) as milliequivalents per liter (meq/L).

NOTE 1—The total cations and total anions (expressed as milliequiva-

lents per liter calcium carbonate should balance within 5 %. A larger difference indicates an error in analysis or the presence of a significant quantity of an ionic species not listed in this guide.

6.3 Determine the organic carbon content of the water using Test Methods D 2579 or D 4839.

6.4 Determine the concentration of:

Sulfide ion—(Test Method D 4658 or see 2.2) (S<sup>-</sup>)  
Free and total chlorine—(Test Method D 1253) (Cl<sub>2</sub>)

6.4.1 Free and total chlorine should be determined on site at the time the sample is collected.

6.5 Determine the:

pH (Test Methods D 1293)  
Temperature  
Turbidity (Test Methods D 1889, Sections 10 through 16)  
Conductivity (Test Methods D 1125)  
Silt density index (Test Methods D 4189)

6.5.1 Silt density index is applicable only to relatively low turbidity waters (less than 1 NTU) such as well water, filtered water, or clarified effluent samples.

6.5.2 pH, temperature, and silt density index should be measured on site at the time the sample is collected.

## 7. Precision and Bias

7.1 The precision and bias of this guide are a function of each individual determination and are given where applicable in the documents that are referenced.

## 8. Keywords

8.1 desalination; desalting; electrodialysis

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