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# Standard Guide for Water Analysis for Reverse Osmosis and Nanofiltration Application[1]

This standard is issued under the fixed designation D4195; 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 analyses that should be performed on any given water sample if reverse osmosis (RO) or nanofiltration (NF) application is being considered. (See also Test Methods D511, D512, D513, D516, D858, D859, D888, D1068, D1179, D1253, D1293, D1889, D3352, D3370, D3561, D3867, D4189, D4194, and D4382.)

1.2 This guide is applicable to waters including brackish waters and seawaters but is not necessarily applicable to waste waters.

1.3 This is a guide only and should not be construed as a delineation of all ions known to exist in waters.

1.4 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.5 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.6 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

## 2. Referenced Documents

2.1 *ASTM Standards:*[2]

D511 Test Methods for Calcium and Magnesium In Water

D512 Test Methods for Chloride Ion In Water

D513 Test Methods for Total and Dissolved Carbon Dioxide in Water

D516 Test Method for Sulfate Ion in Water

D857 Test Method for Aluminum in Water

D858 Test Methods for Manganese in Water

D859 Test Method for Silica in Water

D888 Test Methods for Dissolved Oxygen in Water

D1068 Test Methods for Iron in Water

D1129 Terminology Relating to Water

D1179 Test Methods for Fluoride Ion in Water

D1253 Test Method for Residual Chlorine in Water

D1293 Test Methods for pH of Water

D1889 Test Method for Turbidity of Water (Withdrawn 2007)[3]

D2579 Test Method for Total Organic Carbon in Water (Withdrawn 2002)[3]

D3352 Test Method for Strontium Ion in Brackish Water, Seawater, and Brines

D3370 Practices for Sampling Water from Flowing Process Streams

D3561 Test Method for Lithium, Potassium, and Sodium Ions in Brackish Water, Seawater, and Brines by Atomic Absorption Spectrophotometry

D3867 Test Methods for Nitrite-Nitrate in Water

D4189 Test Method for Silt Density Index (SDI) of Water

D4194 Test Methods for Operating Characteristics of Reverse Osmosis and Nanofiltration Devices

D4382 Test Method for Barium in Water, Atomic Absorption Spectrophotometry, Graphite Furnace

D6161 Terminology Used for Microfiltration, Ultrafiltration, Nanofiltration, and Reverse Osmosis Membrane Processes

2.2 *APHA Standards:*[4]

APHA Standard Methods for the Examination of Water and Wastewater, Sixteenth Edition, 1985, pp. 470–478, Part 427, Sulfite

[1] This guide is under the jurisdiction of ASTM Committee D19 on Water and is the direct responsibility of Subcommittee D19.08 on Membranes and Ion Exchange Materials.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] The last approved version of this historical standard is referenced on www.astm.org.

[4] Available from American Public Health Association (APHA), 800 I Street, NW Washington, DC 20001, http://www.apha.org.

## 3. Terminology

3.1 *Definitions*—For definitions of terms used in this guide, refer to Terminology D1129 and D6161.

## 4. Summary of Guide

4.1 This guide consists of analyzing water samples for ions, gases, suspended material, and organics, as well as measuring the pH and temperature of the water.

## 5. Significance and Use

5.1 The performance of RO or NF membranes is strongly influenced by the composition of the feed solution. Overall salt rejection is dependent upon the ratio of monovalent to polyvalent ions as well as the sum total of ions present. The permeate flow rate of RO or NF devices is also dependent upon the sum total of the ions present and the operating temperature, pressure, and recovery rate. Analyses and measurements performed in this guide will provide vital data for salt rejection and permeate flow projections of RO or NF systems for specific feedwaters.

5.2 The recovery at which a RO or NF system can be safely operated is dependent upon the composition of the feed solution. The analyses and measurements performed in this guide will provide data for the calculation of the maximum recovery of a RO or NF system for a given feed solution.

5.3 The analyses and measurements performed in this guide will be of great assistance in determining the pretreatment requirements for a RO or NF system on a given feedwater.

## 6. Procedure

6.1 Collect a sample of the water to be tested in accordance with Practices D3370.

6.2 Determine the concentration of:

| | | |
|---|---|---|
| Calcium (Ca) | Manganese (Mn) (total and dissolved) | Carbonate ($CO_3^{=}$) |
| Magnesium (Mg) | Iron (Fe) (total, dissolved, and ferrous) | Nitrate ($NO_3^{-}$) |
| Sodium (Na) | Potassium (K) | Fluoride ($F^{-}$) |
| Strontium (Sr) | Bicarbonate ($HCO_3^{-}$) | Phosphate ($PO_4^{=}$) (total) |
| Barium (Ba) | Sulfate ($SO_4^{=}$) | Silica ($SiO_2$) (total and dissolved) |
| Aluminum (Al) (total and dissolved) | Chloride ($Cl^{-}$) | Total dissolved solids (TDS) |

in accordance with the documents referenced in Section 2 of this guide. The results may be expressed as (*a*) mg/L as the ion; (*b*) mg/L as calcium carbonate; or (*c*) meq/L as the ion.

NOTE 1—If the analysis is complete, the total cations and total anions (expressed as mg/L calcium carbonate or meq/L as the ion) should balance within 5 %. That is:

$$([total\ cations] - [total\ anions])/([total\ cations]) \times 100 < \pm 5\ \%$$

NOTE 2—ASTM methods for aluminum, iron, manganese, and nitrate may not be applicable for seawater.

6.3 Determine the organic carbon content of the water using Method D2579.

6.4 Determine the concentration of:

| | |
|---|---|
| Hydrogen sulfide ($H_2S$) (see 2.2) | Oxygen ($O_2$) |
| Free chlorine ($Cl_2$) | Carbon dioxide ($CO_2$) |

in accordance with the documents referenced in Section 2 of this guide. Express the results as mg/L.

6.5 Measure the pH, temperature, turbidity, and silt density index in accordance with the ASTM standards referenced in Section 2 of this guide.

6.5.1 Turbidity should be obtained by the nephelometric method.

6.5.2 Temperature, pH, 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 analysis and are given where applicable in the documents that are referenced.

## 8. Keywords

8.1 nanofiltration; reverse osmosis; water analysis