



Designation: **D3375—16 D3375 – 18**

Standard Test Method for Column Capacity of Particulate Mixed Bed Ion Exchange Materials¹

This standard is issued under the fixed designation D3375; 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 test method covers the determination of the performance of particulate mixed bed ion exchange materials in the regenerated form when used for deionization. It is intended for use in testing unused mixed bed materials and samples of regenerated mixed beds from operating units.

1.2 The values stated in SI units are to be regarded as standard. The values given in parentheses are mathematical conversions to inch-pound units that are provided for information only and are not considered standard.

1.3 *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.*

1.4 *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

[D1125 Test Methods for Electrical Conductivity and Resistivity of Water](#)

[D1129 Terminology Relating to Water](#)

[D1193 Specification for Reagent Water](#)

[D1293 Test Methods for pH of Water](#)

[D1782 Test Methods for Operating Performance of Particulate Cation-Exchange Materials](#)

[D2687 Practices for Sampling Particulate Ion-Exchange Materials](#) [5-18](#)

3. Terminology

3.1 *Definitions*—For definitions of terms related to water, refer to Terminology [D1129](#).

4. Summary of Test Method

4.1 This test method consists of exhausting a column of regenerated mixed bed ion exchange material to a specific end point with an influent solution of known composition and volume.

5. Significance and Use

5.1 This test method can be used to evaluate unused mixed bed ion exchange materials for conformance to specifications. When a representative sample of the mixed bed can be obtained from an operating unit, this test method can be used to evaluate the regeneration efficiency by comparison with the same data obtained with new material from the same manufactured lots, or retained samples of the in-place products.

5.2 This test method provides for the calculation of capacity in terms of the volume of water treated to a conductivity end point.

¹ This test method 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.

Current edition approved July 1, 2016 May 1, 2018. Published July 2016 May 2018. Originally approved in 1975. Last previous edition approved in 2007 2016 as [D3375—95a \(2007\):D3375 – 16](#). DOI: [10.1520/D3375-16](#). [10.1520/D3375-18](#).

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.

5.3 The test method as written assumes that the cation exchange material has been regenerated to the hydrogen form with acid and the anion exchange material has been regenerated with alkali to the hydroxide or free-base form. In certain applications a cation exchange material in the potassium, ammonium, or other monovalent form may be encountered. Such materials may be tested following this procedure using Test Water A (Test Methods **D1782**) as the influent and substituting the hardness end point (Test Methods **D1782**) for the end points prescribed herein.

5.4 In most cases the product tested will be properly mixed and will contain the correct proportions of anion and cation exchange materials. However, if the pH as well as the conductivity of the effluent is measured, the test method will indicate which of the components is present in excess; an acid effluent at breakthrough indicating an excess of regenerated cation exchange groups and an alkaline effluent an excess of regenerated anion exchange groups. In such cases the volumes of the two components obtained in the final backwash will indicate whether this imbalance arises from improper regeneration or from an improper ratio of the two components. It should be noted, however, that not all units are charged with a balanced ratio of anion-exchanging and cation-exchanging groups. Hence, wherever possible, a field sample should be evaluated in comparison with a retained sample of the original charge.

5.5 This test method provides for the calculation of capacity on either a wet weight basis or a volume basis. Although such materials are normally bought and sold in terms of cubic feet, they are actually packaged in wet pounds. Therefore, it is the capacity on a wet weight basis that is directly correlatable to the amount of material in a given shipment.

5.6 Calculation of a volume capacity is based on the exhausted, separated volume of the components after backwashing and resettling the bed. This volume is chosen because it is difficult, if not impossible, to pack a sample of regenerated mixed bed material in a small-diameter column reproducibly.

5.7 This test method may be used to test mixed bed resin cartridges. In such cases the flow rate of test water and the frequency of sampling must be varied to compensate for the approximate volume of resin in the test sample. The test as written assumes a resin volume of approximately 330 mL.

6. Apparatus

6.1 *Test Assembly* (Fig. 1), consisting of the following:

6.1.1 *Column*, transparent supported 2.5 ± 0.25 -cm (1 ± 0.1 -in.) inside diameter and approximately 150 cm (60 in.) long. The bottom of the column shall be closed and provided with an outlet of about 6-mm inside diameter. Connections shall be provided at the top and the bottom for the admission and removal of the exhausting solution as described in 7.4. Adequate means of regulating and measuring flow shall be provided. Support for the sample shall be provided so that the distance from the sample to the column outlet is at least 5 cm. Calibrate the column in such a manner that the volume readings required by the test method can be made. Make all calibration measurements at $25 \pm 5^\circ\text{C}$.

6.1.2 *Sample Support*, so designed that the distance from the sample to the column outlet is at least 5 cm. A suggested supporting bed utilizes quartz, gravel, glass beads, or other material 1.5 to 3.5 mm in diameter, insoluble in the reagents used, and retained on a corrosion-resistant screen.

6.2 Measuring circuit and in-line conductivity cells as described in Test Methods **D1125**. A continuous recorder is recommended.

6.3 *pH Meter*, with associated electrodes as described in Test Methods **D1293**. A continuous recorder is recommended.

7. Reagents

7.1 *Purity of Reagents*—Reagent grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents shall conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available.³ Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.

7.2 *Purity of Water*—All reference to water in this test method shall be understood to mean Reagent Water Type I or II conforming to Specification **D1193**, with the additional requirement that the silica concentration is less than 0.1 mg/L.

7.3 *Ammonium Hydroxide Solution (1+19)*—Carefully pour 50 mL of concentrated ammonium hydroxide (NH_4OH , sp gr 0.90) into 500 mL of water, stirring constantly. Cool to $25 \pm 5^\circ\text{C}$ and dilute to 1 L with water. Mix well.

7.4 *Ion Exchange Test Water D (10 meq/L)*—Prepare a test water containing, in each litre, 0.585 g of oven-dried (105°C) sodium chloride (NaCl). Approximately 25 L of this solution are required for a single test.

7.4.1 To standardize for chloride content, pipet three 100-mL portions. Add one drop of methyl orange indicator solution and one drop of phenolphthalein indicator solution to each and neutralize, if required, by dropwise addition of HNO_3 (1+9) until the

³ *Reagent Chemicals, American Chemical Society Specifications*, American Chemical Society, Washington, DC. For suggestions on the testing of reagents not listed by the American Chemical Society, see *Analar Standards for Laboratory Chemicals*, BDH Ltd., Poole, Dorset, U.K., and the *United States Pharmacopeia and National Formulary*, U.S. Pharmaceutical Convention, Inc. (USPC), Rockville, MD.