Designation: D7513 – 17

Standard Test Method for Capacity of Mixed Bed Ion Exchange Cartridges[1]

This standard is issued under the fixed designation D7513; 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 mixed bed ion exchange resin cartridges in the active form when used for deionization. The test can be used to determine the initial capacity of unused cartridges or the remaining capacity of used cartridges. In this case performance is defined as ion exchange capacity (or throughput) to two defined endpoints. The method does not measure organics and does not attempt to determine the ultimate water quality attainable by the cartridge.

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

D3375 Test Method for Column Capacity of Particulate Mixed Bed IonExchange Materials

D5391 Test Method for Electrical Conductivity and Resistivity of a Flowing High Purity Water Sample

3. Terminology

3.1 *Definitions:*

3.1.1 For definitions of terms used in this standard, refer to Terminology D1129.

4. Summary of Test Method

4.1 This test method consists of exhausting a cartridge of 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 cartridges for conformance to specifications.

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

5.3 The test method as written assumes that the ion exchange resins in the cartridge are either partially or fully converted to the H^+ or OH^- form. Regeneration of the resins is not part of this method.

5.4 This test method provides for the calculation of capacity on a cartridge basis.

5.5 This test method may be used to test different size mixed bed resin cartridges. The flow rate of test water and the frequency of sampling are varied to compensate for the approximate volume of resin in the test cartridge.

6. Apparatus

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

6.1.1 Cartridge, and pressure vessel, if required. Connections shall be provided at the top and the bottom for the admission and removal of the ion exchange test water as described in 7.4.2.

6.1.2 Test solution tank. Adequate means of regulating and measuring flow through the cartridge shall be provided. If the test flow rate (8.1) can not be obtained by gravity feed, then a pump should be used.

6.1.3 Measuring circuit and in-line conductivity cells shall be as described in Test Methods D1125 or D5391. A continuous recorder is recommended.

[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.

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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.

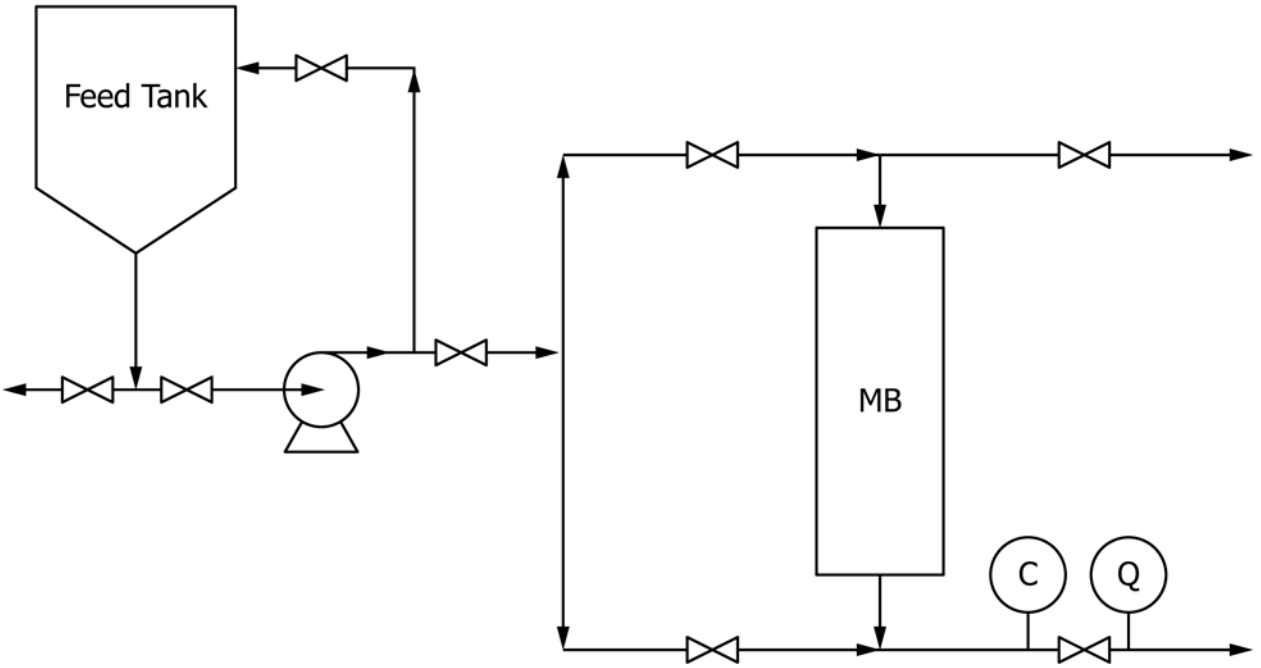

FIG. 1 Typical Apparatus for Performance Testing of Mixed-Bed Ion Exchange Cartridges

7. Reagents and Materials

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.

7.3 *Ammonium Hydroxide Solution* (1+19)—Carefully pour 50 mL of concentrated ammonium hydroxide (NH4OH, sp gr 0.90) into 500 mL of water, stirring constantly. Cool to 25 ± 5°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 color changes from yellow to orange followed by dropwise addition of NH_4OH (1+19) to restore the yellow color. Pipet in 1 mL of K_2CrO_4 solution (50 g/L) and titrate each with standard 0.1 N $AgNO_3$ solution until the color of the supernatant solution changes from yellow to red-orange and persists for 30 s with vigorous swirling. Record the average number of millilitres of $AgNO_3$ solution used to ±0.02 mL.

7.4.2 Calculate the strength of the solution in meq of chloride as follows:

$$\text{Chloride, meq/L} = V \times N \times 10 \quad (1)$$

where:

V = millilitres of $AgNO_3$ solution required for titration, and
N = normality of the $AgNO_3$ solution.

The test solution used should have a concentration of 10 ± 0.5 meq/L of chloride.

NOTE 1—Because of the large quantities of this reagent that are required, it is usually made up semi-quantitatively in large batches and then standardized per the above procedure. If desired, it is acceptable to prepare this reagent quantitatively (as for a primary standard) and then eliminate the above standardization.

7.5 *Methyl Orange Indicator Solution* (1.0 g/L)—Dissolve 0.10 g of methyl orange in water and dilute to 100 mL with water.

7.6 *Nitric Acid* (1+9)—Pour one volume of nitric acid (HNO_3, sp gr 1.42) into nine volumes of water and mix thoroughly.

7.7 *Phenolphthalein Indicator Solution* (10.0 g/L)—Dissolve 1.0 g of phenolphthalein in 100 mL of 95 % ethanol.

NOTE 2—In most cases certain denatured alcohols such as specially denatured Formula Nos. 3A, 30, or 2B may be substituted for ethanol.

7.8 *Potassium Chromate Solution* (50 g/L)—Dissolve 5.0 g of potassium chromate (K_2CrO_4) in 50 mL of water. Dilute to 100 mL with water.

[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 *Annual Standards for Laboratory Chemicals,* BDH Ltd., Poole, Dorset, U.K., and the *United States Pharmacopeia and National Formulary,* U.S. Pharmacopeial Convention, Inc. (USPC), Rockville, MD.