



Designation: D 6302 – 98

An American National Standard

Standard Practice for Evaluating the Kinetic Behavior of Ion Exchange Resins¹

This standard is issued under the fixed designation D 6302; 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 practice is intended to evaluate changes in kinetic performance of ion exchange resins used in mixed beds to produce high purity water. Within strict limitations, it also may be used for comparing resin of different types. This standard does not seek to mimic actual operating conditions. Specific challenge solutions and conditions are specified. At the option of the user, other conditions may be tested.

1.2 *This standard does not purport to address 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 1129 Terminology Relating to Water²

D 1193 Specification for Reagent Water²

D 2187 Test Methods for Physical and Chemical Properties of Particulate Ion-Exchange Resins³

D 2687 Practices for Sampling Particulate Ion-Exchange Materials³

D 5391 Test Method for Electrical Conductivity and Resistivity of a Flowing High Purity Water Sample²

3. Terminology

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

4. Summary of Practice

4.1 An apparatus is described in which a specified volume of regenerated resin sample is mixed with a corresponding new resin. The mixed bed then is operated at a controlled high flow rate on an influent of known composition, and the quality of the effluent is measured by conductivity, and if agreed upon, other appropriate analytical procedures.

5. Significance and Use

5.1 This practice is intended to evaluate changes in the performance of ion exchange resins used in mixed beds operating as polishing systems for solutions of low ionic strength, typically, <10 mg/L dissolved solids, that are intended to produce very high purity effluents. It is recommended that when new resins are installed in a plant it be used to provide a base line against which the future performance of that resin can be judged.

5.2 The conditions of this test must be limiting kinetically, such that kinetic leakage, and not equilibrium leakage, is tested. This leakage is influenced by a combination of influent flow velocity and concentration, as well as bed depth.

5.3 It is recommended that the practice be followed with the resin ratio, flow rate, and influent quality as indicated. The design of the apparatus permits other variations to be used that may be more appropriate to the chemicals used in a specific plant and the nature of its cooling water, but the cautions and limitations noted in the practice must be accommodated.

5.4 It is possible that the cation resin could experience kinetics problems. In many cases, however, the anion resins are more likely to experience the types of degradation or fouling that could lead to impaired kinetics. Testing of field anion and cation resins together is an option, especially when historic data on the mixed bed will be compiled. Recognize, however, that many variables can be introduced, making it difficult to interpret results or to compare to historical or new resin data on separate components.

5.5 Provision is made for calculation of the mass transfer coefficient in the Appendix X1. When such calculation is to be made, a full wet sieve analysis, as described in Test Methods D 2187, also is required. Electronic particle sizing may be substituted if it is referenced back to the wet sieve method.

5.6 This practice is intended to supplement, not displace, other indicators of resin performance, such as exchange capacity, % regeneration, and service experience records.

6. Interferences

6.1 Interferences in the conventional sense are minimal, but variations in test conditions, such as flow rate, temperature, resin ratio, particle size, column configuration, regeneration

¹ This practice is under the jurisdiction of ASTM Committee D-19 on Water and is the direct responsibility of Subcommittee D19.08 on Membrane and Ion Exchange Materials.

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² *Annual Book of ASTM Standards*, Vol 11.01.

³ *Annual Book of ASTM Standards*, Vol 11.02.

efficiency, and influent concentrations can cause major differences in performance. This practice fixes or measures these variables so that true changes in resin kinetics can be demonstrated accurately. Other means will be needed to investigate other resin or equipment problems.

6.2 Contaminant ions in the resins themselves, if present when they are loaded into the test apparatus, may impact performance significantly and must be considered in the interpretation of the results. If the contaminant ions are different from those in the challenge solution, they may be determined by ion chromatography.

6.3 A constant velocity in the range of 50–60 gpm/ft² is used to insure that flow is turbulent and there is little or no resistance to mass transfer from the bulk solution to the resin surfaces. This constant velocity insures the desired testing of surface kinetics at the boundary layer.

7. Equipment

7.1 *Backwash/Separation and Regeneration Apparatus*, see Test Methods D 2187. The column should be 50-mm ID × 600 or 900-mm length.

7.2 *Kinetics Test Apparatus* (see Fig. 1):

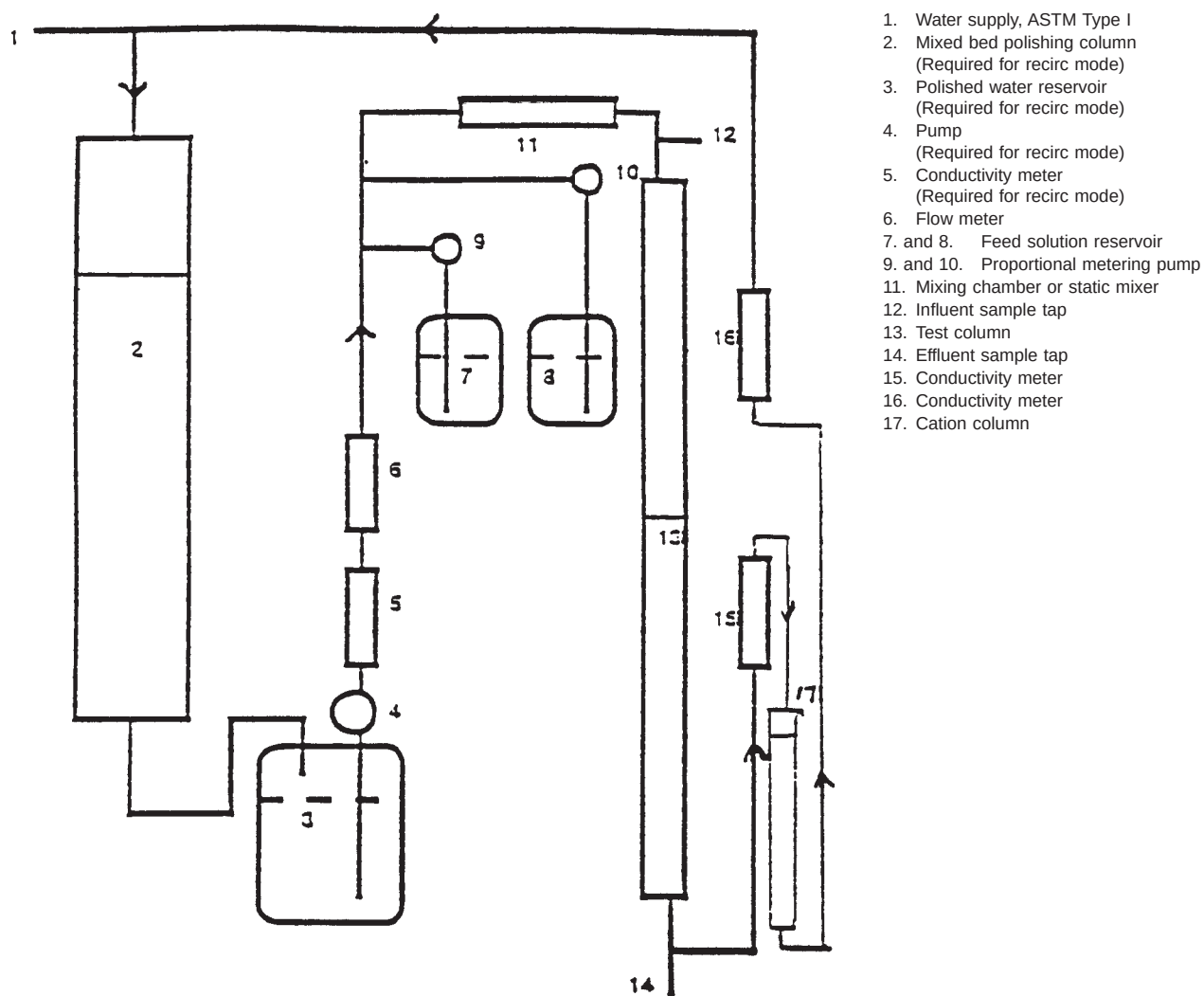
7.2.1 *Feed Pumps*, capable of controlled delivery of 0.5 to 3 mL/min. One is required, the second is optional for use where another reagent, such as ammonia, is to be added.

7.2.2 *Circulating Pump*, capable of delivery of 1 to 1.5 L/min.

7.2.3 *Glass Column*, nominal 25-mm ID × 600 mm. The column shown in Fig. 1 of Test Methods D 2187 may be modified for this purpose.

7.2.4 *Mixing Chamber*.

7.2.5 *Conductivity Meter With Recorder and Temperature Compensation*—See Test Method D 5391.



NOTE 1—Recirculation of water is optional; final effluent also can be directed to drain.

FIG. 1 Test Apparatus for Kinetics