



Designation: D 4456 – 99 (Reapproved 2005)

# Standard Test Methods for Physical and Chemical Properties of Powdered Ion Exchange Resins<sup>1</sup>

This standard is issued under the fixed designation D 4456; 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 These test methods cover the determination of the physical and chemical properties of powdered ion exchange resins and are intended for use in testing new materials. The following test methods are included:

Test Method A—Particle Size Distribution	Sections 5 to 15
Test Method B—Solids Content	16 to 23

1.2 *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 consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

## 2. Referenced Documents

2.1 *ASTM Standards:*<sup>2</sup>

D 1129 Terminology Relating to Water

D 1193 Specification for Reagent Water

D 2687 Practices for Sampling Particulate Ion-Exchange Materials

D 2777 Practice for Determination of Precision and Bias of Applicable Methods of Committee D19 on Water

F 322 Method for Determining Quality of Calibration Particles for Automatic Particle Counters<sup>3</sup>

F 651 Method for Particle Single-Point Calibration by the Median Method<sup>3</sup>

F 658 Practice for Calibration of a Liquid-Borne Particle Counter Using an Optical system Based on Light Extinction

## 3. Terminology

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

<sup>1</sup> These test methods are under the jurisdiction of ASTM Committee D19 on Water and are the direct responsibility of Subcommittee D19.08 on Membranes and Ion Exchange Materials.

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<sup>2</sup> 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.

<sup>3</sup> Withdrawn.

3.2 *Definitions of Terms Specific to This Standard:* Certain terms that relate specifically to these test methods are described as follows:

3.2.1 *powdered ion exchange resin*—an ion exchange resin that has undergone post-manufacturing size reduction to less than 30 μm.

3.2.2 *resin floc*—that voluminous aggregate formed when powdered anion exchange resin and powdered cation exchange resin are slurried together in an aqueous suspension.

## 4. Purity of Reagents

4.1 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,<sup>4</sup> where such specifications are available. 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.

4.2 *Purity of Water*—Unless otherwise indicated, references to water shall be understood to mean Type III reagent water, Specification D 1193.

## TEST METHOD A—PARTICLE SIZE DISTRIBUTION

## 5. Scope

5.1 This test method covers the instrumental determination of the particle-size distribution of powdered ion exchange resins.

## 6. Summary of Test Method

6.1 A sample of powdered ion exchange resin is dispersed uniformly in a suitable aqueous liquid. The resulting suspension is passed through an instrument for measuring particle size distribution by weight, number, or volume. Determinations are

<sup>4</sup> *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.

made of mean particle size, percent below a specified smaller size limit, and percent above a specified larger size limit.

6.2 The analyst should be aware that adequate collaborative data for precision and bias statements as required by Practice **D 2777** are not provided. See Section **15** for details.

## **7. Significance and Use**

7.1 The particle size distribution of powdered ion exchange resins and, more importantly, the derived parameters of mean particle size and percent above and below specified size limits are useful for determining batch to batch variations and, in some cases, can be related to certain aspects of product performance.

7.2 Although automatic multichannel particle size analyzers, of the type described in Section **9**, yield information on the entire distribution of sizes present in a given sample, it has been found that, for this application, the numerical value of three derived parameters may adequately describe the particle size characteristics of the samples: the mean particle diameter (in micrometres), the percent of the sample that falls below some size limit, and the percent of the sample that falls above some size limit.

## **8. Interferences**

8.1 Instruments requiring the use of an aqueous electrolyte for sample suspension, such as described in **9.1.2**, may give results different than those instruments not requiring an electrolyte.

## **9. Apparatus**

9.1 *Instruments for Measuring Particle Size Distribution*,<sup>5</sup> from 2 to 300 µm in size, although it may not be necessary to cover this entire range for any one sample. Satisfactory results have been obtained from instruments with three different principles of operation. Instruments from other manufacturers may be suitable but have not been evaluated.

9.1.1 *Optical Particle Counters*, that pass a collimated light beam through a flowing stream of particles to measure and count each individual particle according to the reduction in light intensity created as it passes through the sensing zone.

9.1.2 *Electrical Resistance Particle Counters*, that set up a voltage difference across an aperture through which a conductive liquid flows to measure and count each particle in the liquid by the change in conductivity or resistance as it passes through the aperture.

9.1.3 *Light-Scattering Instruments*, that view a flowing stream of particles with a laser beam and produce a Fraunhofer diffraction pattern from which a thirteen-segment histogram of volume size distribution is obtained.

9.2 *Sample Handling System*, compatible with the particle-sizing instrument being used.

9.3 *Auxiliary Equipment*, as specified by the manufacturer of the instrument being used.

## **10. Material**

10.1 *Nonionic Wetting Agent*, to assist in the dispersion of the particles in the liquid. The volume to be added will be small, but its cleanliness should be such that the total count in the suspending liquid (with wetting agent) does not exceed 1 % of the total count during analysis of the resin sample.

## **11. Calibration and Standardization**

11.1 Calibrate the instrument over the size range to be measured following either the manufacturer's instructions or Method **F 651**, Practice **F 658**, or Method **F 322**.

## **12. Procedure**

12.1 Into a clean sample container, add measured quantities of clean liquid, clean wetting agent, and a sample of powdered ion exchange resin. The size of the sample container and the quantities of each material to be added will be determined from the operating instructions for the instrument being used for the size range to be measured.

12.2 Agitate the resulting suspension to break up agglomerates and create a uniform dispersion of particles using the equipment specified in the operating instructions for the instrument.

12.3 If necessary, dilute this suspension to provide a concentration of particles not exceeding the maximum specified for proper instrument performance.

12.4 If the sample is diluted, the diluted sample must be agitated in accordance with the instrument operating instructions to create a uniform dispersion of particles.

12.5 Pass the sample through the instrument for analysis.

12.6 Record the results.

## **13. Calculation**

13.1 From the information provided, calculate the mean value and the percent above and below the specified sizes on the basis of weight, number, or volume.

## **14. Report**

14.1 Report the mean particle size in micrometres, and the percent of the sample tested that is below and above certain specified values.

## **15. Precision and Bias**

15.1 Because of the improbability of a single laboratory having all three types of particle size analyzers described in this test method, round-robin testing is not feasible. Also, since the three instruments measure different properties, complete agreement is not expected. However, for aliquots of a single sample of powdered ion exchange resin sent to owners of each type of instrument, the mean particle size values did not differ by more than 20 %.

15.2 A statement of bias may not be obtainable for this test method, since different types of instruments are involved. More fundamentally, however, powdered resin particle size distribution measurements are statistical measurements on irregularly shaped particles, and an absolute, or true, value is not possible.

<sup>5</sup> Instruments from the following manufacturers have been found to be suitable. Instruments from other manufacturers may be suitable, but have not been evaluated: HIAC/ROYCO Division, Pacific Scientific, 141 Jefferson Dr., Menlo Park, CA 94025; Coulter Electronics, Industrial Div., 590 West 20 St., Hialeah, FL 33010; and Leeds & Northrup Co., Microtrac Div., 6950 Bryan Dairy Rd., Largo, FL 33547.