Designation: D8176 – 18 (Reapproved 2023)

Standard Test Method for Mechanically Tapped Density of Activated Carbon (Powdered and Fine Mesh)[1]

This standard is issued under the fixed designation D8176; 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 mechanically tapped density of powdered and fine mesh activated carbon. For the purpose of this test method, "powdered carbon" is defined as having a mean particle diameter less than 45 µm, and "fine mesh carbon" is defined as having a particle size predominately between 80 and 325 U.S. Standard mesh.

1.2 The values in SI units are to be regarded as standard. No other units of measure 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, 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]

D2652 Terminology Relating to Activated Carbon

D2867 Test Methods for Moisture in Activated Carbon

E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

3. Terminology

3.1 *Definitions*—See Terminology D2652.

4. Summary of Test Method

4.1 The sample of powdered or fine mesh carbon is tapped in a graduated cylinder using a tapping device. The mechanically tapped density is determined from the known mass of powdered or fine mesh carbon and the tapped volume.

5. Significance and Use

5.1 This test method is used to determine the density expressed in g/mL for powdered or fine mesh carbon. Due to the nature of the small particles, the density of these carbon types cannot be measured using the same procedure as granular carbon.

6. Apparatus

6.1 *Cylinder*—Graduated 100-mL serialized Class A, calibrated "to contain" (TC), with a base designed to accommodate the cylinder holder in the tapping device.

6.2 *Automated Tapping Device*[3]—Stroke height 3.0 mm ± 0.3 mm, 250 strokes/min ± 15 strokes/min, with built-in adjustable counter capable of delivering 5000 taps.

6.3 *Analytical Balance,* having a sensitivity of 0.1 g or better.

6.4 *Drying Oven,* forced-air circulation.

7. Procedure

7.1 Dry an adequate sample(s) using the procedure described in Test Methods D2867.

7.2 Tare the empty graduated cylinder on the balance.

7.3 Fill the graduated cylinder to 100 mL and weigh to the nearest 0.1 g. Record the mass of the carbon, *W*.

7.4 Place the graduated cylinder into the holder of the tapping device.

[1] This test method is under the jurisdiction of ASTM Committee D28 on Activated Carbon and is the direct responsibility of Subcommittee D28.02 on Liquid Phase Evaluation.

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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] ERWEKA GmbH (Ottostr. 20-22 63150 Heusenstamm, Germany). The ERWEKA SVM-121/221 tapped density tester has been found suitable for this purpose.

Agilent Technologies, Inc. (5301 Stevens Creek Blvd. Santa Clara, CA 95051). The Agilent 350 tapped density tester has been sound suitable for this purpose.

Pharma Alliance Group, Inc. (28518 Constellation Road Valencia, CA 91333). The Pharma Alliance TD-1-2 has been found suitable for this purpose.

Quantachrome Instruments (1900 Corporate Drive Boynton Beach, FL 33426). The Autotap™ and Dualtap™ tapped density analyzers have been found suitable for this purpose.

7.5 Preset the counter to 1000 taps and start the tapping device.

7.6 When tapping is completed, read the tapped volume, V, to the nearest 1 mL by estimating the average level of the carbon surface in the cylinder.

7.7 Place the graduated cylinder back into the holder of the tapping device and repeat steps 7.5 and 7.6 until no changes in the tapped volume of carbon can be observed.

8. Calculation

8.1 Calculate the mechanically tapped density, MTD, as follows:

$$MTD = W / V \quad (1)$$

where:

W = mass of carbon, g, and
V = volume occupied by the carbon in measuring cylinder, mL.

9. Precision and Bias

9.1 The precision of this test method is based on an interlaboratory study of ASTM D8176, Standard Test Method for Mechanically Tapped Density of Activated Carbon, conducted in 2014. Five laboratories participated in this study. Each of the labs was instructed to report three replicate test results for ten different types of activated carbon material. Every "test result" reported represents an individual determination. Practice E691 was followed for the design and analysis of the data; the details are given in ASTM Research Report No. RR:D28-1008.[4]

9.1.1 *Repeatability (r)*—The difference between repetitive results obtained by the same operator in a given laboratory applying the same test method with the same apparatus under constant operating conditions on identical test material within short intervals of time would, in the long run, in the normal and correct operation of the test method, exceed the following values in only one case in 20.

9.1.1.1 Repeatability can be interpreted as the maximum difference between two results obtained under repeatability conditions that is accepted as plausible due to random causes under normal and correct operation of the test method.

9.1.1.2 Repeatability limits are listed in Table 1.

9.1.2 *Reproducibility (R)*—The difference between two single and independent results obtained by different operators applying the same test method in different laboratories using different apparatus on identical test material would, in the long run, in the normal and correct operation of the test method, exceed the following values in only one case in 20.

9.1.2.1 Reproducibility can be interpreted as the maximum difference between two results obtained under reproducibility conditions that is accepted as plausible due to random causes under normal and correct operation of the test method.

9.1.2.2 Reproducibility limits are listed in Table 1.

9.1.3 The above terms ("repeatability limit" and "reproducibility limit") are used as specified in Practice E177.

9.1.4 Any judgment in accordance with 9.1.1 and 9.1.2 would normally have an approximate 95 % probability of being correct. However, the precision statistics obtained in this interlaboratory study must not be treated as exact mathematical quantities which are applicable to all circumstances and uses. The limited number of participants and materials guarantees that there will be times when differences greater than predicted by the interlaboratory study results will arise, sometimes with considerably greater or smaller frequency than the 95 % probability would imply. The repeatability limit and the reproducibility limit should be considered as general guides, and the associated probability of 95 % as only a rough indicator of what can be expected.

9.2 *Bias*—At the time of the study, there was no accepted reference material suitable for determining the bias for this test method; therefore, no statement on bias is being made.

9.3 The precision statement was determined through statistical examination of 150 test results, from five laboratories, on ten different types of activated carbon material. To judge the reliability of two test results, it is recommended to choose the sample type closest in characteristics to the test material.

[4] Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:D28-1008. Contact ASTM Customer Service at service@astm.org.

TABLE 1 Mechanically Tapped Density (g/mL)

Material	Average[A] $\bar{x}$	Repeatability Standard Deviation S_r	Reproducibility Standard Deviation S_R	Repeatability Limit r	Reproducibility Limit R
Coconut 80 × 325 Mesh	0.550	0.019	0.025	0.055	0.071
Wood 80 × 325 Mesh	0.340	0.011	0.015	0.030	0.042
Coal 80 × 325 Mesh	0.532	0.014	0.016	0.038	0.044
Lignite 80 × 325 Mesh	0.450	0.012	0.016	0.034	0.044
Coconut 7–8 Micron Powder	0.557	0.007	0.063	0.020	0.177
Coal 7–8 Micron Powder	0.521	0.009	0.076	0.024	0.214
Coconut Powder	0.377	0.008	0.053	0.023	0.147
Wood Powder	0.362	0.005	0.020	0.015	0.057
Coal Powder	0.468	0.020	0.060	0.055	0.167
Lignite Powder	0.478	0.008	0.053	0.023	0.149

[A] The average of the laboratories' calculated averages.