



# Standard Guide for Gas-Phase Adsorption Testing of Activated Carbon<sup>1</sup>

This standard is issued under the fixed designation D5160; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope

1.1 This guide covers the evaluation of activated carbons for gas-phase adsorption. It presents a procedure for determining the dynamic adsorption capacity,  $N_o$ , and critical bed depth,  $d_c$ , for an activated carbon used to remove a specific adsorbate from a gas stream under conditions chosen by the user.

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. Specific hazards statements are given in Section 8.*

## 2. Referenced Documents

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

D2652 Terminology Relating to Activated Carbon

D2854 Test Method for Apparent Density of Activated Carbon

D2867 Test Methods for Moisture in Activated Carbon

D3467 Test Method for Carbon Tetrachloride Activity of Activated Carbon

E300 Practice for Sampling Industrial Chemicals

## 3. Terminology

3.1 *Definitions:*

3.1.1 *breakthrough*—the appearance in the effluent of a specified concentration of an adsorbate of interest.

3.1.2 Other terms relating to this guide are defined in Terminology D2652.

<sup>1</sup> This guide is under the jurisdiction of ASTM Committee D28 on Activated Carbon and is the direct responsibility of Subcommittee D28.04 on Gas Phase Evaluation Tests.

Current edition approved July 1, 2014. Published September 2014. Originally approved in 1991. Last previous edition approved in 2008 as D5160 – 95 (2008). DOI: 10.1520/D5160-95R14.

<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

## 4. Summary of Guide

4.1 An activated carbon bed that contains a known amount of carbon is challenged with an adsorbate in a gas stream under conditions of flow rate, adsorbate concentration, temperature, pressure, and relative humidity set by the user. The time to breakthrough of a specified concentration of adsorbate is measured. The measurement is repeated using the same conditions but varying the amount of carbon in the bed. For many practical systems, a plot of breakthrough time versus amount of carbon is linear. The slope and  $x$ -intercept of this line can be used to calculate the dynamic capacity,  $N_o$  (expressed as grams adsorbate/grams carbon or grams adsorbate/cm<sup>3</sup> carbon) and critical bed depth,  $d_c$ , characteristic of the activated carbon under the conditions used in the test.

## 5. Significance and Use

5.1 Activated carbon is used extensively for removing gases and vapors from air or other gas streams. The physical and chemical characteristics of an activated carbon can strongly influence its suitability for a given application. The procedure in this guide allows the evaluation of the dynamic adsorption characteristics of an activated carbon for a particular adsorbate under conditions chosen by the user. It is necessary that the user choose test conditions that are meaningful for the application (see Section 9).

5.2 This guide can also be used to evaluate activated carbons that have been impregnated with materials to enhance their effectiveness at removing gases otherwise poorly adsorbed on activated carbon.

5.3 The procedure given in this guide is not generally applicable for evaluation of carbons used as catalysts for such purposes as decomposition of low levels of ozone or oxidation of SO<sub>2</sub> to SO<sub>3</sub>.

5.4 The procedure given in this guide can be applied to reactivated or regenerated activated carbons.

5.5 Fig. 1 shows the adsorbate concentration profile in an activated carbon bed at breakthrough. The bed has a zone at the inlet in which the adsorbate concentration is equal to the influent concentration. In this region the carbon is at equilibrium with adsorbate. The adsorbate concentration in the remainder of the bed drops until at the outlet it is equal to the breakthrough concentration. The shorter the length of this mass