



Designation: D6177 – 19

Standard Practice for Determining Emission Profiles of Volatile Organic Chemicals Emitted from Bedding Sets¹

This standard is issued under the fixed designation D6177; 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 covers the procedures for estimating emission profiles of volatile organic chemicals (VOCs) from bedding sets when a new bedding set is first brought into a house, based on emissions testing in environmental chambers.

1.2 Emission profiles from bedding sets are determined from air concentrations measured in environmental chambers.

1.3 VOC emissions from bedding sets, as in the case of other household furnishings, usually are highest when the products are new. Procedures described in this practice also are applicable to used bedding sets.

1.4 The practice is applicable to VOCs and not to semi-volatile organic chemicals or nonvolatile organic chemicals.

1.5 This practice summarizes procedures for sample selection and handling. This practice also refers to pertinent sampling procedures and analytical methods for emission testing, but does not include technical details on selection of appropriate collection media and analytical methods or on sampling and analytical equipment and associated procedures.

1.6 Emission profiles based on this practice may be used for estimating human exposures to VOCs.

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

1.8 *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.*

1.9 *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.*

¹ This practice is under the jurisdiction of ASTM Committee D22 on Air Quality and is the direct responsibility of Subcommittee D22.05 on Indoor Air.

Current edition approved Nov. 1, 2019. Published November 2019. Originally approved in 1997. Last previous edition approved in 2014 as D6177 – 14. DOI: 10.1520/D6177-19.

2. Referenced Documents

2.1 *ASTM Standards:*²

D1356 Terminology Relating to Sampling and Analysis of Atmospheres

D5116 Guide for Small-Scale Environmental Chamber Determinations of Organic Emissions from Indoor Materials/Products

D5157 Guide for Statistical Evaluation of Indoor Air Quality Models

D5197 Test Method for Determination of Formaldehyde and Other Carbonyl Compounds in Air (Active Sampler Methodology)

D5466 Test Method for Determination of Volatile Organic Compounds in Atmospheres (Canister Sampling Methodology)

D6196 Practice for Choosing Sorbents, Sampling Parameters and Thermal Desorption Analytical Conditions for Monitoring Volatile Organic Chemicals in Air

D6670 Practice for Full-Scale Chamber Determination of Volatile Organic Emissions from Indoor Materials/Products

E355 Practice for Gas Chromatography Terms and Relationships

E1333 Test Method for Determining Formaldehyde Concentrations in Air and Emission Rates from Wood Products Using a Large Chamber

3. Terminology

3.1 *Definitions:*

3.1.1 For definitions and terms used in this practice, refer to Terminology D1356.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *air change rate, n*—the volumetric flow rate (volume per unit time) of air entering a space or enclosure divided by the net volume of air in that space or enclosure (1/s, 1/h).

3.2.1.1 *Discussion*—The entering air may be outdoor air or conditioned air. The space may be an entire building, a room or

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.

a chamber used for material emissions and other testing. When using the term *air change rate*, it is important to specify whether the entering air is outdoor or conditioned, as well as the space being considered. The net volume of air in a space or enclosure may be different from the internal volume when the contents (for example, materials being tested for emissions) displace a significant amount of air within the space or enclosure. Requirements for accounting for the net volume of air in determining the air change rate, including clear identification of when the displacement is considered significant, are covered in the individual standards using the definition.

3.2.2 *bedding set, n*—an ensemble that includes a mattress for sleeping and a supporting box spring.

3.2.3 *emission profile, n*—a time-series of emission rates of one or more chemicals.

3.2.4 *nonvolatile organic chemical, n*—an organic compound with saturation vapor pressure less than 10^{-8} kPa at 25°C.

3.2.5 *semi-volatile chemical, n*—an organic compound with saturation vapor pressure between 10^{-2} and 10^{-8} kPa at 25°C.

3.2.6 *short-term exposure, n*—an exposure of one week or less in duration.

3.2.7 *volatile organic chemical, n*—an organic compound with saturation vapor pressure greater than 10^{-2} kPa at 25°C.

4. Summary of Practice

4.1 This practice describes procedures for determining VOC emission profiles of a bedding set using an environmental chamber.

4.2 This practice includes procedures for selection and handling of samples, and conducting chamber emission tests. Details related to storage and transportation of samples are included in selection and handling. Procedures for conducting chamber tests include selection of test conditions and methods for collection and analysis of air samples.

4.3 The practice also describes procedures for estimating emission profiles from the chamber concentration data.

5. Significance and Use

5.1 The objective of this practice is to provide procedures for estimating emission profiles of VOCs from bedding sets. These profiles can then be used to estimate human inhalation exposures to VOCs emitted from bedding sets. The estimated inhalation exposures ultimately can be used as an input to characterization of health risks from short-term VOC exposures.

5.2 The results of emissions testing for specific raw materials and components, or processes used in manufacturing different bedding sets, can be used to compare their relative impacts on airborne concentrations.

6. Facilities and Equipment

6.1 A facility to determine product or material emissions from bedding sets requires use of a room-size environmental test chamber, typically larger than 22.6 m³. Emissions from components of bedding sets can be characterized in small

chambers ranging in size from a few liters to 5 m³. Chamber testing also requires associated equipment such as a clean-air generation system, monitoring and control systems, and sample collection and analysis equipment (see Practice D6670, Guide D5116, and Test Method E1333).

7. Procedures for Sample Selection and Handling

7.1 The procedures for sample selection and handling include sample selection, packaging for shipping, and shipment and storage.

7.2 Select bedding sets to be tested directly from the production line. Volume of production can be considered as a criterion in selecting the type(s) of bedding set to be tested. Use a random number table to avoid biases in selection.

7.3 The selected bedding set(s) should be wrapped using the manufacturer's normal packaging materials and procedures. Further, to protect from damage during shipping, place the bedding sets in corrugated shipping containers.

7.4 Upon receipt at the testing laboratory, remove the bedding from corrugated shipping containers, but do not remove the manufacturer's normal packaging materials. Inspect for shipping damage and record the arrival condition. To isolate the bedding sets from the surrounding laboratory environment, place each bedding set wrapped in its normal packaging (manufacturer's shipping bag) in a larger outer bag, which has an inert surface.

7.5 Maintain a chain of custody record to note dates, times, and operations performed (such as storage and transportation) for each bedding set.

8. Procedures for Emissions Testing

8.1 Volatile organic emissions from indoor sources such as bedding sets vary widely in the number of chemicals and the strength of their emissions. To characterize emissions fully, the sample collection and analysis system must be capable of quantitative collection and analysis of volatile, polar, and nonpolar compounds. The design and operation of sample collection and analysis systems must be appropriate for the organic chemicals and their concentrations. Such systems include collection of samples using canister sampling methodology (Test Method D5466) or, more often, collection on solid adsorbent tubes (for example, Practice D6196), and instruments to analyze organic emissions (for example, gas chromatographs, see Practice E355). Determination of formaldehyde and other aldehydes are performed using different methods (EPA Compendium, 1990).^{3,4} One of these methods (Test Method D5197), which collects air samples on 2,4-dinitrophenylhydrazine (DNPH)-treated silica gel cartridges followed by high performance liquid chromatography (HPLC), is preferred because of better sensitivity.

³ "Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air," 2nd ed., 1999, EPA/625/R-96/010b, available from United States Environmental Protection Association (EPA), Ariel Rios Bldg., 1200 Pennsylvania Ave, NW, Washington, DC 20460, <http://www.epa.gov>.

⁴ Research Triangle Institute, "Final Report—Performance of Testing in Support of Research by the SPSC Indoor Air Quality Task Force," RTI/5736/00-02RFR, Research Triangle Park, NC, September 1995.