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Standard Guide for Selecting Volatile Organic Compounds (VOCs) and Semi- Volatile Organic Compounds (SVOCs) Emission Testing Methods to Determine Emission Parameters for Modeling of Indoor Environments¹

This standard is issued under the fixed designation D8141; 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 guide is intended to serve as a foundation for understanding when to use emission testing methods designed for volatile organic compounds (VOCs) to determine area-specific emission rates that are typically used in modeling indoor air VOC concentrations and when to use emission testing methods designed for semi-volatile organic compounds (SVOCs) to determine mass transfer emission parameters that are typically used to model indoor air, dust, and surface SVOC concentrations.

1.2 This guide discusses how organic chemicals are conventionally categorized with respect to volatility.

1.3 This guide presents a simplified mass-transfer model describing organic chemical emissions from a material to bulk air. The values of the model parameters are shown to be specific to material/chemical/chamber combinations.

1.4 This guide shows how to use a mass-transfer model to estimate whether diffusion of the chemical within the material or convective mass transfer of the chemical from the surface of the material to the overlying air limits chemical emissions from the material surface.

1.5 This guide describes the range of different chambers that are available for emission testing. The chambers are classified as either dynamic or static and either conventional or sandwich. The chambers are categorized as being optimal to determine either the area-specific emission rate or mass-transfer emission parameters.

1.6 This guide discusses the roles sorption and convective mass-transfer coefficients play in selecting the appropriate emission chamber and analysis method to accurately and efficiently characterize emissions from indoor materials for use in modeling indoor chemical concentrations.

1.7 This guide recommends when to choose an emission test method that is optimized to determine either the area-specific emission rate or mass-transfer emission parameters. For chemicals where the controlling mass-transfer process is unknown, the guide outlines a procedure to determine if the chemical emission is controlled by convective mass transfer of the chemical from the material.

1.8 This guide does not provide specific guidance for measuring emission parameters or conducting indoor exposure modeling.

1.9 Mechanisms controlling emissions from wet and dry materials and products are different. This guide considers the emission of chemicals from dry materials and products. Examples of functional uses of VOCs and SVOCs that this guide applies to include blowing agents, flame retardants, adhesives, plasticizers, solvents, antioxidants, preservatives, and coalescing agents (**1**).² Emission estimations for other VOC and SVOC classes including those generated by incomplete combustion, spray application, or application as a powder (pesticides, termiticides, herbicides, stain repellents, sealants, water repellants) (**1**) may require different approaches than outlined in this guide because these processes can increase short-term concentrations of chemicals in the air independent of the volatility of the chemical and its categorization as a VVOC (very volatile organic compounds), VOC, SVOC, or NVOC (non-volatile organic compounds).

1.10 The effects of the emissions (for example, exposure, and health effects on occupants) are not addressed and are beyond the scope of this guide.

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

1.12 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the*

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

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² The boldface numbers in parentheses refer to the list of references at the end of this standard.

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.

1.13 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:³

- D1356** Terminology Relating to Sampling and Analysis of Atmospheres
- D5116** Guide for Small-Scale Environmental Chamber Determinations of Organic Emissions from Indoor Materials/Products
- D6007** Test Method for Determining Formaldehyde Concentrations in Air from Wood Products Using a Small-Scale Chamber
- D6177** Practice for Determining Emission Profiles of Volatile Organic Chemicals Emitted from Bedding Sets
- D6330** Practice for Determination of Volatile Organic Compounds (Excluding Formaldehyde) Emissions from Wood-Based Panels Using Small Environmental Chambers Under Defined Test Conditions
- D6345** Guide for Selection of Methods for Active, Integrative Sampling of Volatile Organic Compounds in Air (Withdrawn 2018)⁴
- D6670** Practice for Full-Scale Chamber Determination of Volatile Organic Emissions from Indoor Materials/Products
- D7706** Practice for Rapid Screening of VOC Emissions from Products Using Micro-Scale Chambers
- D8142** Test Method for Determining Chemical Emissions from Spray Polyurethane Foam (SPF) Insulation using Micro-Scale Environmental Test Chambers
- D8345** Test Method for Determination of an Emission Parameter for Phthalate Esters and Other Non-Phthalate Plasticizers from Planar Polyvinyl Chloride Indoor Materials for Use in Mass Transfer Modeling Calculations
- E1333** Test Method for Determining Formaldehyde Concentrations in Air and Emission Rates from Wood Products Using a Large Chamber

2.2 Other Documents:

- Directive 2004/42/CE** of the European Parliament and of the Council on the limitation of emissions of volatile organic compounds due to the use of organic solvents in certain paints and varnishes and vehicle refinishing products and amending Directive 1999/13/EC⁵
- Emission Testing Method for CDPH Standard Method V1.2.,**

2017 Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers, Indoor Air Quality Section, Environmental Health Laboratory Branch, Division of Environmental and Occupational Disease Control, California Department of Public Health⁶

I.S. EN 16402:2013 Paints and Varnishes—Assessment of Emissions of Substances from Coatings into Indoor Air—Sampling, Conditioning, and Testing⁷

ISO 16000-6:2011 Indoor Air—Part 6: Determination of Volatile Organic Compounds in Indoor and Test Chamber Air by Active Sampling on Tenax TA Sorbent, Thermal Desorption and Gas Chromatography using MS or MS-FID⁸

ISO 12219-1 Interior Air of Road Vehicles—Part 1: Whole Vehicle Test Chamber—Specification and Method for the Determination of volatile Organic Compounds in Cabin Interiors⁸

3. Terminology

3.1 Definitions:

3.1.1 For definitions of terms commonly used for sampling and analysis of atmospheres, refer to Terminology **D1356**. For definitions and terms commonly used when testing materials and products for emissions, refer to Guide **D5116** and Practices **D6670** and **D7706**.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *conventional chamber, n*—a chamber with test materials on one surface only.

3.2.2 *dynamic chamber, n*—a chamber with input and output airflow.

3.2.3 *sandwich chamber, n*—a chamber with test materials on opposite surfaces (typically top and bottom); typically used to reduce the surface-to-volume ratio to mitigate wall sorption effects; sometimes these chambers are referred to as material-air-material chambers.

3.2.4 *static chamber, n*—a sealed chamber with no airflow.

4. Significance and Use

4.1 Emissions of VOCs are typically controlled by internal mass-transfer limitations (for example, diffusion through the material), while emissions of SVOCs are typically controlled by external mass-transfer limitations (migration through the air immediately above the material). The emission of some chemicals may be controlled by both internal and external mass-transfer limitations. In addition, due to their lower vapor pressure, SVOCs generally adsorb to different media (chamber walls, building materials, particles, and other surfaces) at greater rates than VOCs. This sorption can increase the amount

³ 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.

⁴ The last approved version of this historical standard is referenced on www.astm.org.

⁵ Available at <https://www.legislation.gov.uk/>.

⁶ Available from Underwriters Laboratories (UL), UL Headquarters, 333 Pfingsten Road, Northbrook, IL, 60062, <http://www.ul.com>.

⁷ Available from European Committee for Standardization (CEN), Avenue Marnix 17, B-1000, Brussels, Belgium, <http://www.cen.eu>.

⁸ Available from International Organization for Standardization (ISO), ISO Central Secretariat, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, <https://www.iso.org>.