Designation: D6196 – 23

Standard Practice for Choosing Sorbents, Sampling Parameters and Thermal Desorption Analytical Conditions for Monitoring Volatile Organic Chemicals in Air[1]

This standard is issued under the fixed designation D6196; 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 is intended to assist in the selection of sorbents and procedures for the sampling and analysis of ambient (**1**),[2] indoor (**2**), and workplace (**3, 4**) atmospheres for a variety of common volatile organic compounds (VOCs). It may also be used for measuring emissions from materials in small or full scale environmental chambers or for human exposure assessment.

1.2 This practice is based on the sorption of VOCs from air onto selected sorbents or combinations of sorbents. Sampled air is either drawn through a tube containing one or a series of sorbents (pumped sampling) or allowed to diffuse, under controlled conditions, onto the sorbent surface at the sampling end of the tube (diffusive or passive sampling). The sorbed VOCs are subsequently recovered by thermal desorption and analyzed by capillary gas chromatography.

1.3 This practice applies to three basic types of samplers that are compatible with thermal desorption: (*1*) pumped sorbent tubes containing one or more sorbents; (*2*) axial passive (diffusive) samplers (typically of the same physical dimensions as standard pumped sorbent tubes and containing only one sorbent); and (*3*) radial passive (diffusive) samplers.

1.4 This practice recommends a number of sorbents that can be packed in sorbent tubes for use in the sampling of vapor-phase organic chemicals; including volatile and semi-volatile organic compounds which, generally speaking, boil in the range 0 °C to 400 °C (v.p. 15 kPa to 0.01 kPa at 25 °C).

1.5 This practice can be used for the measurement of airborne vapors of these organic compounds over a wide concentration range.

1.5.1 With pumped sampling, this practice can be used for the speciated measurement of airborne vapors of VOCs in a concentration range of approximately 0.1 μg/m^3 to 1 g/m^3, for individual organic compounds in 1 L to 10 L air samples. Quantitative measurements are possible when using validated procedures with appropriate quality control measures.

1.5.2 With axial diffusive sampling, this practice is valid for the speciated measurement of airborne vapors of volatile organic compounds in a concentration range of approximately 100 μg/m^3 to 100 mg/m^3 for individual organic compounds for an exposure time of 8 h or 1 μg/m^3 to 1 mg/m^3 for individual organic compounds for an exposure time of four weeks.

1.5.3 With radial diffusive sampling, this practice is valid for the measurement of airborne vapors of volatile organic compounds in a concentration range of approximately 5 μg/m^3 to 5 mg/m^3 for individual organic compounds for exposure times of one to six hours.

1.5.4 The upper limit of the useful range is almost always set by the linear dynamic range of the gas chromatograph column and detector, or by the sample splitting capability of the analytical instrumentation used.

1.5.5 The lower limit of the useful range depends on the noise level of the detector and on blank levels of analyte or interfering artifacts (or both) on the sorbent tubes.

1.6 This procedure can be used for personal and fixed location sampling. It cannot be used to measure instantaneous or short-term fluctuations in concentration. Alternative 'grab sampling' procedures using canister air samplers (for example, Test Method D5466) may be suitable for monitoring instantaneous or short term fluctuations in air concentration. Alternatives for on-site measurement include, but are not limited to, gas chromatography, real-time mass spectrometry detectors and infrared spectrometry.

1.7 The sampling method gives a time-weighted average result.

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

[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.

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[2] The bold face numbers in parentheses refer to the list of references at the end of this practice.

1.9 *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.*

1.10 *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

D3670 Guide for Determination of Precision and Bias of Methods of Committee D22

D3686 Practice for Sampling Atmospheres to Collect Organic Compound Vapors (Activated Charcoal Tube Adsorption Method)

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

E355 Practice for Gas Chromatography Terms and Relationships

2.2 *ISO Standards:*[4]

ISO 5725 Accuracy (Trueness and Precision) of Measurement Methods and Results

ISO 6145-10 Gas Analysis. Preparation of Calibration Gas Mixtures. Permeation Method

ISO 13137 Workplace Atmospheres: Pumps for Personal Sampling of Chemical and Biological Agents. Requirements and Test Methods

ISO 16017-1 Indoor, Ambient, and Workplace Air – Sampling and Analysis of Volatile Organic Compounds by Sorbent Tube/Thermal Desorption/Capillary Gas Chromatography – Part 1: Pumped Sampling

ISO 16017-2 Indoor, Ambient, and Workplace Air – Sampling and Analysis of Volatile Organic Compounds by Sorbent Tube/Thermal Desorption/Capillary Gas Chromatography – Part 2: Diffusive Sampling

ISO 16107 Workplace Atmospheres—Protocol for Evaluating the Performance of Diffusive Samplers

ISO GUM Guide to the Expression of Uncertainty in Measurement

2.3 *CEN Standards:*[5]

EN 482 Workplace Atmospheres: General Requirements for the Performance of Procedures for the Measurement of Chemical Agents

EN 838 Workplace Atmospheres: Requirements and Test Methods for Diffusive Samplers for the Determination of Gases and Vapours

EN 1076 Workplace Atmospheres: Pumped Sorbent Tubes for the Determination of Gases and Vapours. Requirements and Test Methods

EN 13528-3 Ambient Air Quality—Diffusive Samplers for the Determination of Concentrations of Gases and Vapours – Part 3: Guide to Selection, Use, and Maintenance

EN 14662-1 Ambient Air Quality – Standard Method for Measurement of Benzene Concentrations – Part 1: Pumped Sampling Followed by Thermal Desorption and Gas Chromatography

EN 14662-4 Ambient Air Quality – Standard Method for Measurement of Benzene Concentrations – Part 4: Diffusive Sampling Followed by Thermal Desorption and Gas Chromatography

2.4 *EPA Method:*[6]

EPA Method TO-17 Determination of Volatile Organic Compounds in Ambient Air Using Active Sampling Onto Sorbent Tubes

3. Terminology

3.1 *Definitions*—Refer to Terminology D1356 and Practice E355 for definitions of terms used in this practice.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *breakthrough volume*—the volume of a known atmosphere that can be passed through the tube before the concentration of the vapor eluting from non-sampling end of the tube reaches 5 % of the applied test concentration.

3.2.2 *desorption efficiency*—the ratio of the mass of analyte desorbed from a sampling device to that applied.

3.2.3 *diffusive (passive) sampler*—a device that is capable of collecting gases and vapors from an atmosphere at rates controlled by gaseous diffusion through a static air layer (diffusion gap), permeation through a membrane or some other diffusion-barrier, but which does not involve the active movement of air through the sampler.

3.2.4 *axial diffusive sampler*—a tube-form device with precisely controlled dimensions that samples gaseous organic chemicals in air diffusively through one end of the tube onto the sorbent surface held inside the tube at a fixed distance from the sampling end.

3.2.5 *radial diffusive sampler*—a tube form device which allows controlled diffusive sampling around the walls of the sampler; that is, parallel to the radius. The ends of a radial sampler are sealed.

3.2.6 *diffusive uptake rate or diffusive sampling rate (U)*—the rate at which the diffusive sampler collects a particular gas or vapor from the atmosphere, expressed in nanograms per parts per million (volume/volume) per minute ($ng.ppm^{-1}$ (V/V)

[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] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

[5] Available from European Committee for Standardization (CEN), 36 rue de Stassart, B-1050, Brussels, Belgium, http://www.cenorm.be.

[6] Available from United States Environmental Protection Agency (EPA), William Jefferson Clinton Bldg., 1200 Pennsylvania Ave., NW, Washington, DC 20460, http://www.epa.gov.