



Designation: D8560 – 24

Standard Guide for Determination of Airborne PFAS in the Indoor Air Environment¹

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1. Scope

1.1 This guide describes methods for determining Per- and Polyfluoroalkyl Substances (PFAS) concentrations in indoor air.

1.2 This guide is focused on PFAS measurement technologies applicable to indoor air (including in vehicles and indoor workplaces) and other relevant air volumes such as, air in chambers, bags, or both. The described technologies were developed for indoor air; they may or may not be applicable to other types of air samples.

1.3 This guide describes available technologies and methods that can be used to measure indoor air PFAS concentrations in the gaseous or particulate phases, or both, in indoor air.

1.4 This guide describes each method and its advantages and limitations.

1.5 This guide does not attempt to differentiate between the effectiveness of the methods nor determine equivalence of the methods.

1.6 The sorbent-based sampling strategies addressed in this guide are for PFAS compounds with a molecular mass greater than 200 g mol^{-1} (**1, 2, 3**).² Compounds less than 200 g mol^{-1} , such as CF_4 , C_2F_6 , or PFAS degradation products may require real-time analytical methods described in this guide or other methods that are not presented here.

1.7 *Units*—The values stated in SI units are to be regarded as the 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 standard-*

ization 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

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

D7968 Test Method for Determination of Polyfluorinated Compounds in Soil by Liquid Chromatography Tandem Mass Spectrometry (LC/MS/MS)

D7979 Test Method for Determination of Per- and Polyfluoroalkyl Substances in Water, Sludge, Influent, Effluent, and Wastewater by Liquid Chromatography Tandem Mass Spectrometry (LC/MS/MS)

D8141 Guide for Selecting Volatile Organic Compounds (VOCs) and Semi-Volatile Organic Compounds (SVOCs) Emission Testing Methods to Determine Emission Parameters for Modeling of Indoor Environments

D8421 Test Method for Determination of Per- and Polyfluoroalkyl Substances (PFAS) in Aqueous Matrices by Cosolvation followed by Liquid Chromatography Tandem Mass Spectrometry (LC/MS/MS)

D8535 Test Method for Determination of Per- and Polyfluoroalkyl Substances (PFAS) in Soil/Biosolid Matrices by Solvent Extraction, Filtering, and Followed by Liquid Chromatography Tandem Mass Spectrometry (LC/MS/MS)

E3302 Guide for PFAS Analytical Methods Selection

2.2 EPA Standards:⁴

EPA Method 537.1 Determination of Selected Per- and Polyfluorinated Alkyl Substances in Drinking Water by

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 a list of references at the end of this standard.

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 United States Environmental Protection Agency (EPA), William Jefferson Clinton Bldg., 1200 Pennsylvania Ave., NW, Washington, DC 20460, <http://www.epa.gov>.

Solid Phase Extraction and Liquid Chromatography/ Tandem Mass Spectrometry (LC/MS/MS)

US EPA Method 533 Determination of per- and polyfluoroalkyl substances in drinking water by isotope dilution anion exchange solid phase extraction and liquid chromatography/tandem mass spectrometry

US EPA Method 8327 Per- and Polyfluoroalkyl Substances (PFAS) by Liquid Chromatography/Tandem Mass Spectrometry (LC/MS/MS)

US EPA OTM-45 Other Test Method 45 Measurement of Selected Per- and Polyfluorinated Alkyl Substances from Stationary Sources

2.3 ISO Standards:⁵

ISO 16000-6 Indoor air — Part 6: Determination of organic compounds (VOC, VOC, SVOC) in indoor and test chamber air by active sampling on sorbent tubes, thermal desorption and gas chromatography using MS or MS FID

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

3. Terminology

3.1 For definitions of terms commonly used for sampling and analysis of atmospheres, refer to Terminology **D1356**.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *perfluoroalkyl and polyfluoroalkyl substances (PFAS)*, *n*—fluorinated substances that contain at least one fully fluorinated methyl or methylene carbon atom.

3.2.1.1 *Discussion*—Perfluoroalkyl chemicals are those chemicals where all hydrogen (H) atoms associated with the carbon (C) atoms of an aliphatic chain have been replaced by fluorine (F) atoms. Polyfluoroalkyl chemicals are those chemicals in which not all H atoms of the aliphatic chain have been replaced by F atoms. Not all PFAS will be found in air (Section 6) and not all PFAS have quantifiable airborne methods (Section 7).

3.2.2 *perfluorooctane sulfonic acid (PFOS)*, *n*—a chemical compound having an eight-carbon fluorocarbon chain and a sulfonic acid functional group.

3.3 Acronyms:

5MS	5 %-Phenyl 95 % methylpoly/arylene siloxane
ACFs	Activated carbon fiber felts
AOF	Adsorbable organic fluorine
CI	Chemical ionization
CIC	Combustion ion chromatography
CIMS	Chemical ionization mass spectrometer
diPAP	Fluorotelomer phosphate diester
DPPO	2,6-diphenyl-p-phenylene oxide
EI	Electron ionization
EOF	Extractable organic fluorine
EtFOSA	N-Ethyl perfluorooctane sulfonamide
EtFOSE	N-Ethyl perfluorooctane sulfonamido ethanol
ESI	Electrospray ionization
FASAs	Fluoroalkyl sulfonamides
FASEs	Fluoroalkyl sulfonamido ethanols
FBET	2-Perfluorobutyl ethanol (4:2)
FDET	2-Perfluorodecyl ethanol (10:2)
FHEA	2-Perfluorohexyl ethanoic acid (6:2)
FHET	2-Perfluorohexyl ethanol (6:2)
FMACrs	Fluorotelomer methacrylates
FOEA	2-Perfluorooctyl ethanoic acid (8:2)
FOSA	Perfluorooctane sulfonamide
FOSAs	Referring to combination of MeFOSA and EtFOSA
FOET	2-Perfluorooctyl ethanol (8:2)
FTA	Fluorotelomer acids
FTACrs	Fluorotelomer acrylates
FTUCAs	Fluorotelomer unsaturated carboxylic acids
FTOHs	Fluorotelomer alcohols
GC	Gas chromatography
GFFs	Glass fiber filters
HPLC	High-performance liquid chromatography
HFPO-DA	Hexafluoropropylene oxide dimer acid
HRMS	High-resolution mass spectrometry
IDL	Instrument detection limit
LC	Liquid chromatography
MeFBSA	N-Methyl perfluorobutane sulfonamide
MeFBSE	N-Methyl perfluorobutane sulfonamido ethanol
MeFOSA	N-Methyl perfluorooctane sulfonamide
MeFOSE	N-Methyl perfluorooctane sulfonamido ethanol
MeFOSEA	N-Methyl perfluorooctane sulfonamidethyl acrylate
MDL	Method detection limit
MTBE	Methyl tert-butyl ether
MS	Mass spectrometry
MS/MS	Tandem mass spectrometry
NCI	Negative chemical ionization
ND	Non-detect
NPSDBR	Nonionic polystyrene divinylbenzene resin
OECD	Organization for Economic Co-operation and Development
PAHs	Polycyclic aromatic hydrocarbons
PAPs	Polyfluoroalkyl phosphoric acid esters
PCBs	Polychlorinated biphenyls
PCI	Positive chemical ionization
PE	Polyethylene
PEG	Polyethylene glycol
PFAAs	Perfluoroalkyl acids
PFAS	Perfluoroalkyl and Polyfluoroalkyl Substances
PFASA	Perfluoroalkane sulfonamides
PFBA	Perfluorobutanoic acid
PFBS	Perfluorobutane sulfonic acid
PFCAs	Perfluorocarboxylic acids
PFDA	Perfluorodecanoic acid

⁵ Available from International Organization for Standardization (ISO), ISO Central Secretariat, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, <https://www.iso.org>.