Designation: D7049 – 24

An American National Standard

Standard Test Method for Metalworking Fluid Aerosol in Workplace Atmospheres[1]

This standard is issued under the fixed designation D7049; 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 test method covers a procedure for the determination of both total collected particulate matter and extractable mass metalworking fluid aerosol concentrations in the range of 0.07 to 5 mg/m^3 in workplace atmospheres.

1.2 This test method describes a standardized means of collecting worker exposure information that can be compared to existing exposure databases, using a test method that is also more specific to metal removal fluids.

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

1.4 *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.*

1.5 *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:*[2]

D1356 Terminology Relating to Sampling and Analysis of Atmospheres

D3195/D3195M Practice for Rotameter Calibration

D4532 Test Method for Respirable Dust in Workplace Atmospheres Using Cyclone Samplers

D4840 Guide for Sample Chain-of-Custody Procedures

D5337 Practice for Setting and Verifying the Flow Rate of Personal Sampling Pumps

E1542 Terminology Relating to Occupational Health and Safety

2.2 *U.S. Government Regulations:*[3]

29 CFR 1910.1000 Air Contaminants

29 CFR 1910.1450 Occupational Exposure to Hazardous Chemicals in Laboratories

3. Terminology

3.1 *Definitions:*

3.1.1 For definitions of terms relating to this test method, refer to Terminologies D1356 and E1542.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *extractable mass, n*—the amount of material removed by liquid extraction of the filter using a mixed-polarity solvent mixture.

3.2.1.1 *Discussion*—This mass is an approximation of the metal removal fluid portion of the workplace aerosol.

3.2.2 *filter set, n*—a group of filters from the same production lot that are weighed and assembled into the filter cassettes at one time.

3.2.2.1 *Discussion*—The filter set may be used for sampling on multiple days with the appropriate field blanks being submitted for each sampling day.

3.2.3 *metal removal fluids, n*—the subset of metalworking fluids that are used for wet machining or grinding to produce the finished part; such fluids are often characterized as straight, soluble, semisynthetic, and synthetic.

3.2.3.1 *Discussion*—Metalworking fluids addressed by this test method include straight or neat oils not intended for further dilution with water, and water-miscible soluble oils, semi-synthetics, and synthetics, which are intended to be diluted with water before use. Metalworking fluids become contaminated during use in the workplace with a variety of workplace substances including, but not limited to: abrasive particles, tramp oils, cleaners, dirt, metal fines and shavings, dissolved metal and hard water salts, bacteria, fungi, microbiological decay products, and waste. These contaminants can cause changes in the lubricity and cooling ability of the metal

[1] This test method is under the jurisdiction of ASTM Committee E34 on Occupational Health and Safety and is the direct responsibility of Subcommittee E34.50 on Health and Safety Standards for Metal Working Fluids.

Current edition approved March 1, 2024. Published March 2024. Originally approved in 2004. Last previous edition approved in 2017 as D7049 – 17. DOI: 10.1520/D7049-24.

[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.

[3] Available from Occupational Safety and Health Administration (OSHA), 200 Constitution Ave., NW, Washington, DC 20210, http://www.osha.gov.

removal fluid and may have the potential to adversely affect the health and welfare of employees exposed to the contaminated metal removal fluid.

4. Summary of Test Method

4.1 Workplace air is drawn into a 37 mm filter cassette containing a tared polytetrafluoroethylene (PTFE) filter for a measured period of time. The total particulate matter concentration is calculated from the mass gain of the filter and the volume of air sampled.

4.2 The filter is extracted with a ternary mixture of both nonpolar and polar solvents, a second mixture of methanol and water, dried, and reweighed. The extractable mass concentration is calculated from the loss of mass following extraction and the volume of air sampled.

4.3 As a cost-control procedure, the nonspecific total particulate matter concentration may be used in place of the extractable mass if the total particulate concentration is acceptable to the user of this test method.

5. Significance and Use

5.1 This test method covers the gravimetric measurement[4] of metal removal fluid aerosol concentrations in workplace atmospheres.

5.2 This test method provides total particulate matter concentrations for comparison with historical exposure databases collected with the same technology.

5.3 This test method provides an extension to current non-standardized methods by adding an extractable mass concentration which reduces interferences from nonmetal removal fluid aerosols.

5.4 This test method does not address differences between metal removal fluid types, but it does include extraction with a broad spectrum of solvent polarity to adequately remove many of the current fluid formulations from insoluble background aerosol.[5]

5.5 This test method does not identify or quantify any specific putative toxins in the workplace that can be related to metal removal fluid aerosols or vapors.

5.6 This test method does not address the loss of semivolatile compounds from the filter during or after collection.

6. Interferences

6.1 The total particulate matter portion of this test method is not specific to metal removal fluid in the workplace and is subject to positive bias by other aerosol sources.

6.2 The extractable mass concentration measurement improves the specificity of this test method by eliminating insoluble background aerosol from the determination of the metal removal fluid aerosol concentration. This is an important consideration at low exposure limits.

6.3 Any metal removal fluid components that are insoluble in either extraction solvent mixture will not be measured in the extractable mass fraction.

6.4 The total particulate and extractable mass concentrations measured with this test method are subject to a negative bias, to the extent that semivolatile compounds are lost from the filter during sampling.

6.4.1 Samples of workplace atmospheres in which metal removal fluids containing lower viscosity petroleum fractions or volatile alkanolamines are used may be particularly subject to this negative bias both during sampling and during storage preceding analysis.

6.5 Any insoluble materials that are lost from the filter during the extraction process will be reported as extractable mass, resulting in a positive bias.

7. Apparatus

7.1 The sampling unit consists of a sampling pump and filter cassette sampler connected by tubing.

7.1.1 *Sampling Pump,* a constant-flow personal sampling pump capable of a flow rate of 2.0 L/min (±5 %) through the filter cassette for a full work shift (8 h).

7.1.2 *Filter Cassette,* a closed-face (4 mm opening) two or three-piece 37 mm filter cassette with filter support pad and inlet and outlet plugs.

7.1.3 *Filter,* the filter shall be a 2 µm PTFE membrane filter.

7.1.4 *Clips or Harnesses,* to provide a suitable means of attaching the pump and filter cassette to the worker for breathing zone sampling.

7.1.5 *Tubing,* flexible, for connecting the sampling pump to the sampler.

7.2 *Field Blank,* a filter cassette prepared for sampling that has been taken to the workplace and handled in the same manner as the analytical filters, but which has not had any air drawn through it.

7.3 *Precision Flow Meter,* for calibration of sampler flow rates (for example, bubble flow meter or dry seal flow meter).

7.4 *Rotameter,* calibrated in accordance with Practice D3195/D3195M for field check of sampler flow rate.

7.5 *Weighing Room,* with temperature and humidity control to allow weighing under reproducible environmental conditions of 22 ± 2 °C and ±5 % relative humidity in a range of 30 to 55 %.

7.6 *Analytical Balance,* capable of weighing to ±0.001 mg.

7.7 *Antistatic Strips,* of ^{210}Po, <200 days old since packaging.

7.8 *Plane-Parallel Press,* for assembling of filter cassettes.[6]

7.9 *Chemical Desiccator,* with indicating $CaSO_4$ desiccant, for drying of filters.

[4] "NIOSH Method 0500," in *NIOSH Manual of Analytical Methods*, 4th ed. National Institute for Occupational Safety and Health, Cincinnati, OH. Available from National Institute for Occupational Safety and Health, 4676 Columbia Pkwy., Cincinnati, OH 45226.

[5] "NIOSH Method 5524," in *NIOSH Manual of Analytical Methods*, 5th ed., http://www.cdc.gov/niosh/nmam.

[6] See Test Method D4532, where a plane-parallel press is described (to aid in the assembly of sampling cassettes).