



Designation: D7439 – 21

Standard Test Method for Determination of Elements in Airborne Particulate Matter by Inductively Coupled Plasma–Mass Spectrometry¹

This standard is issued under the fixed designation D7439; 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 specifies a procedure for sample preparation and analysis of airborne particulate matter for the content of metals and metalloids in workplace air samples using inductively coupled plasma–mass spectrometry (ICP-MS). This test method can be used for other air samples provided the user ensures the validity of the test method (by ensuring that appropriate data quality objectives can be achieved).

1.2 This test method assumes that samples will have been collected in accordance with Test Method [D7035](#) with consideration of guidance regarding wall deposits provided in Guide [D8358](#).

1.3 This test method should be used by analysts experienced in the use of ICP-MS, the interpretation of spectral and matrix interferences and procedures for their correction.

1.4 This test method specifies a number of alternative methods for preparing test solutions from samples of airborne particulate matter. One of the specified sample preparation methods is applicable to the measurement of soluble metal or metalloid compounds. Other specified methods are applicable to the measurement of total metals and metalloids.

1.5 It is the user's responsibility to ensure the validity of this test method for samples collected from untested matrices.

1.6 [Table 1](#) provides a non-exclusive list of metals and metalloids for which one or more of the sample dissolution methods specified in this document is applicable.

1.7 This test method is not applicable to compounds of metals and metalloids that are present in the gaseous or vapor state.

1.8 [Table 3](#) provides examples of instrumental detection limits (IDL) that can be achieved with this test method. [Table 5](#) provides examples of method detection limits (MDL) that can be achieved.

¹ This test method is under the jurisdiction of ASTM Committee [D22](#) on Air Quality and is the direct responsibility of Subcommittee [D22.04](#) on Workplace Air Quality.

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1.9 No detailed operating instructions are provided because of differences among various makes and models of suitable ICP-MS instruments. Instead, the analyst shall follow the instructions provided by the manufacturer of the particular instrument. This test method does not address comparative accuracy of different devices or the precision between instruments of the same make and model.

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

1.11 This test method contains notes that are explanatory and are not part of the mandatory requirements of the method.

1.12 *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.*

1.13 *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:*²

[D1193](#) Specification for Reagent Water

[D1356](#) Terminology Relating to Sampling and Analysis of Atmospheres

[D4185](#) Test Method for Measurement of Metals in Workplace Atmospheres by Flame Atomic Absorption Spectrophotometry

[D4840](#) Guide for Sample Chain-of-Custody Procedures

[D5011](#) Practices for Calibration of Ozone Monitors Using Transfer Standards

[D6785](#) Test Method for Determination of Lead in Workplace

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.

TABLE 1 Applicable Metals and Metalloids

Element	Symbol	CASRN ^A	Element	Symbol	CASRN ^A	Element	Symbol	CASRN ^A
Aluminum	Al	7429-90-5	Antimony	Sb	7440-36-0	Arsenic	As	7440-38-2
Barium	Ba	7440-39-3	Beryllium	Be	7440-41-7	Bismuth	Bi	7440-69-9
Boron	B	7440-42-8	Cadmium	Cd	7440-43-9	Calcium	Ca	7440-70-2
Cesium	Cs	7440-46-2	Chromium	Cr	7440-47-3	Cobalt	Co	7440-48-4
Copper	Cu	7440-50-8	Gallium	Ga	7440-55-3	<i>Germanium^B</i>	Ge	7440-56-4
Hafnium	Hf	7440-58-6	Indium	In	7440-74-6	Iron	Fe	7439-89-6
Lead	Pb	7439-92-1	Lithium	Li	7439-93-2	Magnesium	Mg	7439-95-4
Manganese	Mn	7439-96-5	<i>Mercury^B</i>	<i>Hg</i>	7439-97-6	Molybdenum	Mo	7439-98-7
Nickel	Ni	7440-02-0	<i>Niobium^B</i>	<i>Nb</i>	7440-03-1	Phosphorus	P	7723-14-0
Platinum	Pt	7440-06-4	Potassium	K	7440-09-7	Rhodium	Rh	7440-16-6
Selenium	Se	7782-49-2	Silver	Ag	7440-22-4	Sodium	Na	7440-23-5
Tellurium	Te	13494-80-9	Thallium	Tl	7440-28-0	Tin	Sn	7440-31-5
Tungsten	W	7440-33-7	Uranium	U	7440-61-1	Vanadium	V	7440-62-2
Yttrium	Y	7440-65-5	Zinc	Zn	7440-66-6	Zirconium	Zr	7440-67-7

^A CASRN = Chemical Abstracts Service Registry Number

^B For the elements in italics, there is insufficient information available on the effectiveness of the sample dissolution procedures in [Annex A1](#) through [Annex A5](#).

Air Using Flame or Graphite Furnace Atomic Absorption Spectrometry

- [D7035](#) Test Method for Determination of Metals and Metalloids in Airborne Particulate Matter by Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES)
- [D7202](#) Test Method for Determination of Beryllium in the Workplace by Extraction and Optical Fluorescence Detection
- [D7440](#) Practice for Characterizing Uncertainty in Air Quality Measurements
- [D8344](#) Practice for Ammonium Bifluoride and Nitric Acid Digestion of Airborne Dust and Dust-Wipe Samples for the Determination of Metals and Metalloids
- [D8358](#) Guide for Assessment and Inclusion of Wall Deposits in the Analysis of Single-Stage Samplers for Airborne Particulate Matter
- [E288](#) Specification for Laboratory Glass Volumetric Flasks
- [E438](#) Specification for Glasses in Laboratory Apparatus
- [E691](#) Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method
- [E882](#) Guide for Accountability and Quality Control in the Chemical Analysis Laboratory
- [E1154](#) Specification for Piston or Plunger Operated Volumetric Apparatus
- [E1613](#) Test Method for Determination of Lead by Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES), Flame Atomic Absorption Spectrometry (FAAS), or Graphite Furnace Atomic Absorption Spectrometry (GFAAS) Techniques (Withdrawn 2021)³
- [E3193](#) Test Method for Measurement of Lead (Pb) in Dust by Wipe, Paint, and Soil by Flame Atomic Absorption Spectrophotometry (FAAS)
- [E3203](#) Test Method for Determination of Lead in Dried Paint, Soil, and Wipe Samples by Inductively Coupled Plasma-Optical Emission Spectroscopy (ICP-OES)

2.2 ISO Standards:⁴

- [ISO 1042](#) Laboratory glassware — One-mark volumetric flasks
- [ISO 3585](#) Borosilicate glass 3.3 — Properties
- [ISO 4225](#) Air quality — General aspects — Vocabulary
- [ISO 8655](#) Piston-operated volumetric apparatus (6 parts)
- [ISO 15202](#) Workplace air — Determination of metals and metalloids in airborne particulate matter by inductively coupled plasma atomic emission spectrometry (3 parts)
- [ISO 17294](#) Water quality — Application of inductively coupled plasma mass spectrometry (ICP-MS) (2 parts)
- [ISO 18158](#) Workplace air — Terminology

3. Terminology

3.1 *Definitions*—For definitions of other terms used in this test method, refer to Terminology [D1356](#).

3.1.1 *analytical recovery, n*—ratio of the mass of analyte measured to the known mass of analyte in the sample, expressed as a percentage. **D6785**

3.1.2 *batch, n*—a group of field or quality control (QC) samples that are collected or processed together at the same time using the same reagents and equipment. **E3203**

3.1.3 *blank solution, n*—solution prepared by taking a reagent blank, laboratory blank or field blank through the same procedure used for sample dissolution. **ISO 15202**

3.1.3.1 *Discussion*—A blank solution may need to be subjected to further operations, such as addition of an internal standard, if the sample solutions are subjected to such operations in order to produce test solutions that are ready for analysis.

3.1.4 *calibration blank solution, n*—calibration solution prepared without the addition of any stock standard solution or working standard solution. **ISO 15202**

3.1.4.1 *Discussion*—The concentration of the analyte(s) of interest in the calibration blank solution is taken to be zero.

³ The last approved version of this historical standard is referenced on www.astm.org.

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