



Standard Test Method for Measurement of Airborne Metal and Metal Oxide Nanoparticle Surface Area Concentration in Inhalation Exposure Chambers using Krypton Gas Adsorption¹

This standard is issued under the fixed designation E2864; 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 determination of surface area of airborne metal and metal oxide nanoparticles in inhalation exposure chambers for inhalation toxicology studies. Surface area may be measured by gas adsorption methods using adsorbates such as nitrogen, krypton, and argon (Brunauer et al., 1938; Anderson, 1975; Gregg and Sing, 1982) (**1, 2, 3**)² or by ion attachment and mobility-based methods (Ku and Maynard, 2005) (**4**). This test method is specific to the measurement of surface area by gas adsorption by krypton gas adsorption. The test method permits the use of any modern commercial krypton adsorption instruments but strictly defines the sample collection, outgassing, and analysis procedures for metal and metal oxide nanoparticles. Use of krypton is required due to the low overall surface area of particle-laden samples and the need to accurately measure the background surface area of the filter used for sample collection. Instrument-reported values of surface area based on the multipoint Brunauer, Emmett and Teller (BET) equation (Brunauer et al., 1938; Anderson, 1975; Gregg and Sing, 1982) (**1, 2, 3**) are used to calculate surface area of airborne nanoparticles collected on a filter.

1.2 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard. State all numerical values in terms of SI units unless specific instrumentation software reports surface area using alternate units.

1.3 *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 and health practices and determine the applicability of regulatory limitations prior to use.*

¹ This test method is under the jurisdiction of ASTM Committee E56 on Nanotechnology and is the direct responsibility of Subcommittee E56.02 on Physical and Chemical Characterization.

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

2. Referenced Documents

2.1 ASTM Standards:³

B922 Test Method for Metal Powder Specific Surface Area by Physical Adsorption

C1274 Test Method for Advanced Ceramic Specific Surface Area by Physical Adsorption

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

E2456 Terminology Relating to Nanotechnology

2.2 ISO Standards:⁴

ISO 9277 Determination of the Specific Surface Area of Solids by Gas Adsorption using the BET Method

ISO 18757 Fine Ceramics (Advanced Ceramics, Advanced Technical Ceramics)—Determination of Specific surface Area of Ceramic Powders by Gas Adsorption using the BET Method

3. Terminology

3.1 *Definitions*—For additional definitions related to nanotechnology, see Terminology **E2456**.

3.1.1 *nanoparticles, n*—in nanotechnology, a sub-classification of ultrafine particle with lengths in two or three dimensions greater than 0.001 micrometre (1 nanometre) and smaller than about 0.1 micrometre (100 nanometres) and which may or may not exhibit a size-related intensive property.

E2456

3.1.2 *adsorbate, n*—material that has been retained by the process of adsorption.

B922

3.1.3 *adsorbent, n*—any solid having the ability to concentrate or collect significant quantities of other substances on its surface.

B922

3.1.4 *adsorption, n*—a process in which fluid molecules are concentrated or collected on a surface by chemical or physical forces, or both.

B922

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>.