



Standard Guide for Measurement of Particle Size Distribution of Nanomaterials in Suspension by Nanoparticle Tracking Analysis (NTA)¹

This standard is issued under the fixed designation E2834; 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 guide deals with the measurement of particle size distribution of suspended particles, from ~10 nm to the onset of sedimentation, sample dependent, using the nanoparticle tracking analysis (NTA) technique. It does not provide a complete measurement methodology for any specific nanomaterial, but provides a general overview and guide as to the methodology that should be followed for good practice, along with potential pitfalls.

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

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.*

2. Referenced Documents

2.1 ASTM Standards:²

C322 Practice for Sampling Ceramic Whiteware Clays

E456 Terminology Relating to Quality and Statistics

E1617 Practice for Reporting Particle Size Characterization Data

E2490 Guide for Measurement of Particle Size Distribution of Nanomaterials in Suspension by Photon Correlation Spectroscopy (PCS)

2.2 ISO Standards:³

ISO 13320 Particle Size Analysis—Laser Diffraction Methods

ISO 13321 Particle Size Analysis—Photon Correlation Spectroscopy

¹ This guide is under the jurisdiction of ASTM Committee E56 on Nanotechnology and is the direct responsibility of Subcommittee E56.02 on Characterization: Physical, Chemical, and Toxicological Properties.

Current edition approved April 1, 2012. Published May 2012. DOI: 10.1520/E2834-12.

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

ISO 14488 Particulate Materials—Sampling And Sample Splitting for the Determination of Particulate Properties
ISO 22412 Particle Size Analysis—Dynamic Light Scattering (DLS)

3. Terminology

3.1 Definitions:

3.1.1 *diffusion coefficient, n*—a measure to characterize the rate a particular molecule or particle moves in a particular medium when driven by random thermal agitation (Brownian motion).

3.1.1.1 *Discussion*—After measurement, the value is to be inputted into the Stokes-Einstein equation (Eq 1, see 7.2.1.2(3)). Diffusion coefficient units in nanoparticle tracking analysis (NTA) measurements are typically cm^2/s , rather than the correct SI units of m^2/s .

3.1.2 *repeatability, n*—in NTA and other particle sizing techniques, this usually refers to a measure of the precision of repeated consecutive measurements on the same group of particles under identical conditions and is normally expressed as a relative standard deviation (RSD) or coefficient of variation (CV).

3.1.2.1 *Discussion*—The repeatability value reflects the stability (instrumental, but mainly the sample) of the system over time. Changes in the sample could include dispersion, aggregation and settling.

3.1.3 *reproducibility, n*—in NTA and particle sizing this usually refers to a measure of the deviation of the results obtained from the first aliquot to that obtained for the second and further aliquots of the same bulk sample (and therefore is subject to the homogeneity or heterogeneity of the starting material and the sampling method employed). Normally expressed as a relative standard deviation (RSD) or coefficient of variation (CV).

3.1.3.1 *Discussion*—In a heterogenous and polydisperse (for example, slurry) system, it is often the largest error when repeated samples are taken. Other definitions of reproducibility also address the variability among single test results gathered from different laboratories when inter-laboratory testing is undertaken, or operator-to-operator, instrument-to-instrument, location-to-location, or even day-to-day. It is to be noted that the same group of particles can never be measured in such a