



Designation: **B822—17 B822 – 20**

## Standard Test Method for Particle Size Distribution of Metal Powders and Related Compounds by Light Scattering<sup>1</sup>

This standard is issued under the fixed designation B822; 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 reappraisal. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reappraisal.

### 1. Scope\*

1.1 This test method covers the determination of the particle size distribution by light scattering, reported as volume percent, of particulate materials including metals and compounds.

1.2 This test method applies to analyses with both aqueous and nonaqueous dispersions. In addition, analysis can be performed with a gaseous dispersion for materials that are hygroscopic or react with a liquid carrier.

1.3 This test method is applicable to the measurement of particulate materials in the range of 0.4 to 2000  $\mu\text{m}$ , or a subset of that range, as applicable to the particle size distribution being measured.

1.4 Units—The values stated in SI units are to be regarded as the standard. No other units of measurement are included in this standard.

1.5 *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.*

1.6 *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:<sup>2</sup>

[B215 Practices for Sampling Metal Powders](#)

[B243 Terminology of Powder Metallurgy](#)

[B821 Guide for Liquid Dispersion of Metal Powders and Related Compounds for Particle Size Analysis](#)

[E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods](#)

[E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method](#)

[E1617 Practice for Reporting Particle Size Characterization Data](#)

#### 2.2 ISO Standard:<sup>3</sup>

[ISO13320-1 Particle Size Analysis—Laser Diffraction Methods—Part 1: General Principles](#)

<sup>1</sup> This test method is under the jurisdiction of ASTM Committee B09 on Metal Powders and Metal Powder Products and is the direct responsibility of Subcommittee B09.02 on Base Metal Powders.

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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

<sup>3</sup> Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

\*A Summary of Changes section appears at the end of this standard

### 3. Terminology

3.1 *Definitions*—Definitions of powder metallurgy terms can be found in Terminology B243.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *background*—*background, n*—extraneous scattering of light by elements other than the particles to be measured; includes scattering by contamination in the measurement path.

3.2.2 *Fraunhofer Diffraction*—*Diffraction, n*—the optical theory that describes the low-angle scattering of light by particles that are large compared to the wavelength of the incident light.<sup>4</sup>

3.2.3 *Mie Scattering*—*Scattering, n*—the complex electromagnetic theory that describes the scattering of light by spherical particles. ~~It is usually applied to particles with diameters that are close to the wavelength of the incident light. The real and imaginary indices of light refraction of the particles are needed.~~

3.2.3.1 *Discussion*—

It is usually applied to particles with diameters that are close to the wavelength of the incident light. The real and imaginary indices of light refraction of the particles are needed.<sup>4</sup>

3.2.4 *multiple scattering*—*scattering, n*—the rescattering of light by a particle in the path of light scattered by another particle. ~~This usually occurs in heavy concentrations of a particle dispersion.~~

3.2.4.1 *Discussion*—

This usually occurs in heavy concentrations of a particle dispersion.

### 4. Summary of Test Method

4.1 A prepared sample of particulate material is dispersed in water, or a compatible organic liquid, and circulated through the path of a light beam or some other suitable light source. A dry sample may be aspirated through the light in a carrier gas. The particles pass through the light beam and scatter it. Photodetector arrays collect the scattered light that is converted to electrical signals, which are then analyzed in a microprocessor. The signal is converted to a size distribution using Fraunhofer Diffraction or Mie Scattering, or a combination of both. Scattering information is analyzed assuming a spherical model. Calculated particle sizes are therefore presented as equivalent spherical diameters. Additional information pertaining to the general principles of particle size distribution analysis by light scattering can be found in ISO Standard 13320-1.

### 5. Significance and Use

5.1 Reported particle size measurement is a function of both the actual particle dimension and shape factor as well as the particular physical or chemical properties being measured. Caution is required when comparing data from instruments operating on different physical or chemical parameters or with different particle size measurement ranges. Sample acquisition, handling, and preparation can also affect reported particle size results.

5.1.1 It is important to recognize that the results obtained by this test method, or any other method for particle size determination using different physical principles, may disagree. The results are strongly influenced by the physical principles employed by each method of particle size analysis. The results of any particle sizing method should be used only in a relative sense; they should not be regarded as absolute when comparing results obtained by other methods.

5.2 Light scattering theory has been available for many years for use in the determination of particle size. Several manufacturers of testing equipment now have units based on these principles. Although each type of testing equipment uses the same basic principles for light scattering as a function of particle size, different assumptions pertinent to application of the theory, and different models for converting light measurements to particle size, may lead to different results for each instrument. Therefore, the use of this test method cannot guarantee directly comparable results from different types of instruments.

5.3 Knowledge of the particle size distribution of metal powders is useful in predicting the powder-processing behavior and

<sup>4</sup> Muly, E. C., Frock, H. N., "Industrial Particle Size Measurement Using Light Scattering," *Optical Engineering*, Vol 19, No. 6, 1980, pp. 861–869.