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Standard Test Method for Particle Size Distribution of Metal Powders and Related Compounds by Light Scattering[1]

This standard is issued under the fixed designation B 822; 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 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 0.1 to 1000 µm, or a subset of that range, as applicable to the particle size distribution being measured.

1.4 The values stated in SI units are to be regarded as the 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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

B 215 Practices for Sampling Finished Lots of Metal Powders[2]

B 243 Terminology of Powder Metallurgy[2]

B 821 Guide for Liquid Dispersion of Metal Powders and Related Compounds for Particle Size Analysis[2]

3. Terminology

3.1 *Definitions*—Definitions of powder metallurgy terms can be found in Terminology B 243.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *background*—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*—the optical theory that describes the low-angle scattering of light by particles that are large compared to the wavelength of the incident light.[3]

3.2.3 *Mie Scattering*—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]

3.2.4 *multiple scattering*—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.

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.

5. Significance and Use

5.1 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

[1] This test method is under the jurisdiction of ASTM Committee B09 on Metal Powders and Metal Powder Productsand is the direct responsibility of Subcommittee B09.02on Base Metal Powders.

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[2] *Annual Book of ASTM Standards*, Vol 02.05.

[3] Muly, E. C., Frock, H. N., "Industrial Particle Size Measurement Using Light Scattering," *Optical Engineering*, Vol 19, No 6, 1980, pp. 861–869.

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