
Standard Method of Test for Particle Size Analysis of Hydraulic Cement and Related Materials by Light Scattering

AASHTO Designation: T 353-14 (2022)

Technically Revised: 2014

Reviewed but Not Updated: 2022

Editorially Revised: 2021

Technical Subcommittee: 3a, Cement, Lime, and Concrete Materials



**American Association of State Highway and Transportation Officials
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1. SCOPE

- 1.1. This test method covers the determination of the particle size distribution (PSD) of hydraulic cement and related compounds by means of the laser diffraction technique, reported as volume percent of particulate materials.¹ This test method applies to analyses with both nonaqueous and gaseous dispersions. This test method is applicable to the measurement of particulate materials in the size range of 0.4 to 2000 μm .
- 1.2. The values stated in SI units are to be regarded as the standard.
- 1.3. *This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety concerns associated with its use. It is the responsibility of the user of this standard to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*
- 1.4. *The quality of the results produced by this standard are dependent on the competence of the personnel performing the procedure and the capability, calibration, and maintenance of the equipment used. Agencies that meet the criteria of R 18 are generally considered capable of competent and objective testing/sampling/inspection/etc. Users of this standard are cautioned that compliance with R 18 alone does not completely assure reliable results. Reliable results depend on many factors; following the suggestions of R 18 or some similar acceptable guideline provides a means of evaluating and controlling some of those factors.*

2. REFERENCED DOCUMENTS

- 2.1. AASHTO Standard:
 - R 18, Establishing and Implementing a Quality Management System for Construction Materials Testing Laboratories
- 2.2. ASTM Standards:
 - B822, Standard Test Method for Particle Size Distribution of Metal Powders and Related Compounds by Light Scattering
 - C115/C115M, Standard Test Method for Fineness of Portland Cement by the Turbidimeter (withdrawn 2018; no replacement)
 - C204, Standard Test Methods for Fineness of Hydraulic Cement by Air-Permeability Apparatus
 - C219, Standard Terminology Relating to Hydraulic and Other Inorganic Cements

- [C430](#), Standard Test Method for Fineness of Hydraulic Cement by the 45- μm (No. 325) Sieve
- [E1458](#), Standard Test Method for Calibration Verification of Laser Diffraction Particle Sizing Instruments Using Photomask Reticles
- [E1617](#), Standard Practice for Reporting Particle Size Characterization Data

2.3. *ISO Standards:*

- ISO 13320:2009, Particle Size Analysis—Laser Diffraction Methods—Part 1: General Principles
- ISO 14887:2000, Sample Preparation—Dispersing Procedures for Powders in Liquids

2.4. *Other Documents:*

- Ferraris, C. F., V. A. Hackley, A. I. Avilés, and C. E. Buchanan, Jr. *Analysis of the ASTM Round-Robin Test on Particle Size Distribution of Portland Cement: Phase I*. NISTIR 6883. National Institute of Standards and Technology, Gaithersburg, MD, May 2002. (<http://fire.nist.gov/bfrlpubs/build02/PDF/b02015.pdf>).
- Ferraris, C. F., V. A. Hackley, A. I. Avilés, and C. E. Buchanan, Jr. *Analysis of the ASTM Round-Robin Test on Particle Size Distribution of Portland Cement: Phase II*. NISTIR 6931. National Institute of Standards and Technology, Gaithersburg, MD, December 2002. (<http://fire.nist.gov/bfrlpubs/build02/PDF/b02084.pdf>).
- Ferraris, C. F., V. A. Hackley, and A. I. Avilés. "Measurement of Particle Size Distribution in Portland Cement Powder: Analysis of ASTM Round Robin Studies," *Cement, Concrete and Aggregates Journal*, Vol. 26, No. 2. ASTM International, West Conshohocken, PA, 2004, pp. 71–81. (http://www.astm.org/DIGITAL_LIBRARY/JOURNALS/CEMENT/PAGES/CCA11920.htm)
- Ferraris, C. F., W. Guthrie, A. I. Avilés, M. Peltz, R. Haupt, and B. S. MacDonald. *Certification of SRM 114q: Phase II (Particle Size Distribution)*. NIST SP 260-166. National Institute of Standards and Technology, Gaithersburg, MD, November 2006. (<http://www.nist.gov/srm/upload/SP260-166.pdf>)

3. TERMINOLOGY

3.1. For general terms or for definitions related to cement, refer to [ASTM C219](#).

3.2. *Definitions for Terms Specific to This Standard:*

- 3.2.1. *laser diffraction*—a method for determining the particle size distribution based on the detection and analysis of the angular distribution of scattered light, produced by a laser, passing through a dilute dispersion of particles.
- 3.2.2. *background*—extraneous scattering of light by elements other than the particles to be measured; includes scattering by contamination in the measurement path.
- 3.2.3. *Fraunhofer diffraction*—the optical theory that describes the low-angle scattering of light by particles that are large compared with the wavelength of the incident light.
- 3.2.4. *Mie theory*—the electromagnetic theory that describes the scattering of light by spherical particles.
- 3.2.5. *multiple scattering*—the rescattering of light by a particle in the path of light scattered by another particle; typically occurs in dispersions with high particle concentrations.
- 3.2.6. *wet method*—the particles are dispersed in isopropyl alcohol, then recirculated through the path of the light beam.