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Standard Guide for Worldwide Published Standards Relating to Particle and Spray Characterization[1]

This standard is issued under the fixed designation E1919; 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 covers the awareness and use of available standard methods for characterizing solid and liquid particles, and provides information for subsequent evaluation and standardization.

1.2 The principal purpose of this guide is the identification of particle characterization standard methods that have been developed and published by various standards organizations worldwide. Although this is an extensive list of methods, it is not all inclusive. WD working drafts, CD committee drafts, DIS draft International Standards and FDIS final Draft International Standards may not be completed documents. These standards have been divided into the following twelve sections related to particle characterization.

Section 1 — Representation and Treatment of Data
Section 2 — Sedimentation, Classification, Gravity and Centrifugal Methods
Section 3 — Surface Area and Porosity Measurement Methods
Section 4 — Sieving Methods
Section 5 — Electrical Sensing Methods
Section 6 — Laser Diffraction Methods
Section 7 — Photon Correlation Spectroscopy Methods
Section 8 — Image Analysis Methods
Section 9 — Single Particle Light Interaction Methods
Section 10 — Small Angle X-Ray Scattering Method
Section 11 — Sampling Methods
Section 12 — General Methods and Information

2. Terminology

2.1 *Abbreviations:*

ASME—American Society of Mechanical Engineers

BSI—British Standard Specification

DIN—Deutsches Institut fur Normung; German Standard Institution

DIN and VDI—German Standards

ISO—International Organization for Standardization

ISO/DIS—Draft International Standards

JSA/JIS—Japanese Standards Association/Japanese Industrial Standard

MPIF—Metal Powders Industry Federation

NF X—Normalization Francaise (AFNOR) French Standards (E) - English Translation

TAPPI—Technical Association of Pulp and Paper Industry

VDI—Verein Deutscher Ingenieure; Society of German Engineers

CD—Committee Draft

DIS—Draft International Standard

FDIS—Final Draft International Standard

TS—Technical Specification

WD—Working Draft

3. Significance and Use

3.1 Reported particle size measurement is a function of both the actual dimension and/or shape factor as well as the particular physical or chemical properties of the particle 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.

4. Referenced Documents

SECTION 1—REPRESENTATION AND TREATMENT OF DATA

4.1 *Related Standards*:

4.1.1 *ASTM Standards:*[2]

ASTM E177	Practice for Use of the Terms Precision and Bias in ASTM Test Methods
ASTM E799	Practice for Determining Data Criteria and Processing for Liquid Drop Size Analysis
ASTM E1617	Practice for Reporting Particle Size Characterization Data
ASTM F658	Practice for Calibration of a Liquid-Borne Particle Counter Using an Optical System Based Upon Light Extinction

4.1.2 *British Standard:*[3]

BS 3406	Test Method for the Determination of Particle Size Distribution

4.1.3 *German Standards:*[4]

[1] This guide is under the jurisdiction of ASTM Committee E29 on Particle and Spray Characterization and is the direct responsibility of subcommittee E29.03 on International Cooperation on Particle and Spray Characterization.

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[2] Available from ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

[3] Available from British Standards Institute (BSI), 389 Chiswick High Rd., London W4 4AL, U.K., http://www.bsi-global.com.

[4] Available from Beuth Verlag GmbH (DIN-- DIN Deutsches Institut fur Normung e.V.), Burggrafenstrasse 6, 10787, Berlin, Germany, http://www.en.din.de.

DIN 66 141	Representation of (grain) Particle Size Distributions, Basic Standard
DIN 66 142 T 1	Representation and Identification of Separated Fractions of Dispersed Matter; Fundamentals
DIN 66 142 T 2	Representation and Identification of Separated Fractions of Dispersed Matter, Application to Analytical Separations
DIN 66 142 T 3	Representation and Identification of Separated Fractions to Dispersed Matter, Selection and Determination of Parameters of
DIN 66 143	Representation of (Grain) Particle Size Distributions, Power Function Grid
DIN 66 144	Representation of (Grain) Particle Size Distributions, Logarithmic Gaussian Grid
DIN 66 145	Representation of (Grain) Particle Size Distributions; RRSB Grid
DIN EN 1822	High efficiency particulate air filters (HEPA and ULPA) — Part 2: Aerosol production, measuring equipment, particle counting statistics

4.1.4 *ISO Standards:*[5]

ISO 9276-1	Representation of Results of Particle Size Analysis - Part 1 - Graphical Representation
ISO 9276-2	Representation of Results of Particle Size Analysis—Part 2: Calculation of Average Particle Sizes/Diameters and Moments from Particle Size Distributions
ISO 9276-3	Representation of Results of Particle Size Analysis—Part 3: Adjustment of an Experimental Curve to a Reference Model
ISO 9276-4	Representation of Results of Particle Size Analysis—Part 4: Characterization of a Classification Process
ISO 9276-5	Representation of Results of Particle Size Analysis—Part 5: Methods of Calculation Relating to Particle Size Analyses Using Logarithmic Normal Probability Distribution
ISO 9276-6	Representation of Results of Particle Size Analysis—Part 6: Descriptive and Quantitative Representation of Particle Shape and Morphology

4.1.5 *French Standards:*[6]

NF X 11-632	Particle Size Analysis—Expression of Experimental Results of Particle Size Analysis (E)
NF X 11-634	Particle Size Analysis—Characterization of the Size and Form of the Elements of a Granular Population
NF X 11-635	Particle Size Analysis—Representation of Particle Size Distributions - Reference Models
NF X 11-636	Particle Size Analysis—Representation of Particle Size Distributions - Adjustment of an Experimental Cumulative Curve to a Reference Model—Case of Sieving

SECTION 2—SEDIMENTATION, CLASSIFICATION, GRAVITY AND CENTRIFUGAL METHODS

4.2 *Related Standards*:

4.2.1 *ASTM Standards:*[2]

ASTM B330	Test Method for Fisher Number of Metal Powders and Related Compounds
ASTM B430	Test Method for Particle Size Distribution of Refractory Metal Powders and Related Compounds by Turbidimetry
ASTM B761	Test Method for Particle Size Distribution of Metal Powders Related Compounds by X-Ray Monitoring of Gravity Sedimentation
ASTM C721	Test Method for Average Particle Size of Alumina and Silica Powders by Air Permeability
ASTM C775	Test Method for Particle-Size Analysis of Whiteware Clays
ASTM C958	Test Method for Particle Size Distribution of Alumina or Quartz by X-Ray Monitoring of Gravity Sedimentation
ASTM C1282	Test Method for Determining the Particle Size Distribution of Advanced Ceramics by Centrifugal Photosedimentation

4.2.2 *British Standards:*[3]

BS 3406: Part 2	Recommendations for Gravitational Liquid Sedimentation Methods for Powders and Suspensions
BS 3406: Part 3	Air Elutriation Methods
BS 3406: Part 6	Recommendations for Centrifugal Liquid Sedimentation Methods for Powders and Suspensions

4.2.3 *German Standards:*[4]

DIN 66 111	Particle Size Analysis; Sedimentation Analysis; Principles
DIN 66 111 Bbl.1	Particle Size Analysis; Sedimentation Analysis; Principles; Evaluation Equations for Determination of Quantities in the Field of Centrifugal Force
DIN 66 115	Test Method for Particle Size Analysis, Sedimentation Analysis in the Gravitational Field
DIN 66 116	Grain (particle) Size Analysis; Sedimentation Analysis in the Gravitational Field, Sedimentation Balance
DIN 66 118	Particle Size Analysis, Size Analysis by Air Classification, Fundamentals
DIN 66 119	Particle Size Analysis, Size Analysis by Air Classification with Gravitation Counterflow
DIN 66 120	Particle Size Analysis, Size Analysis by Air Classification with Centrifugal Counterflow Classifier

4.2.4 *ISO Standards:*[5]

ISO 10076	Metallic Powders - Determination of Particle Size Distribution by Gravitational Sedimentation in a Liquid and Attenuation Measurement
ISO 13317-1	Determination of Particle Size Distribution by Gravitational Liquid Sedimentation Methods Part 1: General Principles and Guidelines
ISO 13317-2	Determination of Particle Size Distribution by Gravitational Liquid Sedimentation Methods Part 2: Fixed Pipette Method
ISO 13317-3	Determination of Particle Size Distribution by Gravitational Liquid Sedimentation Methods Part 3: X-Ray Gravitational Technique
ISO 13318-1	Determination of Particle Size Distribution by Centrifugal Liquid Sedimentation Methods Part 1: General Principles and Guidelines
ISO 13318-2	Determination of Particle Size Distribution by Centrifugal Liquid Sedimentation Methods Part 2: Photocentrifuge Method
ISO 13318-3	Determination of Particle Size Distribution by Centrifugal Liquid Sedimentation Methods Part 3: Centrifugal X-Ray Method

4.2.5 *Japanese Standards:*[7]

JIS Z8820	General Rules for the Determination of Particle Size Distribution by Sedimentation in Liquid
JIS Z8821	Determination of Particle Size Distribution by the Sedimentation in Liquid Using the Pipette Apparatus
JIS Z8822	Determination of Particle Size Distribution by the Weight of Sedimentation in Liquid

4.2.6 *French Standards:*[6]

NF X 11-680	Test Method for Particle Size Analysis—Separation by Fluids - Particle Size Analysis by Gravity Sedimentation in a Liquid Medium (E)
NF X 11-681	Test Method for Particle Size Analysis—Particle Size Analysis by Gravity Sedimentation in a Liquid Medium (E)
NF X 11-682	Test Method for Particle Size Analysis—Particle Size Analysis by Gravitational Liquid Sedimentation - Photosedimentation Technique (E)
NF X 11-683	Test Method for Particle Size Analysis—Particle Size Analysis of a Powder by Variable Height Gravity Sedimentation in a Liquid - Method Using X-ray Absorption Measurement (E)
NF X 11-684	Test Method for Particle Size Analysis—Particle Size Analysis by Cumulative Sedimentation in a Static Liquid - Sedimentation Balance Method
NF X 11-685	Test Method for Particle Size Analysis by Centrifugal Sedimentation in a Liquid Which is at Rest in Relation to the Axis of Centrifugation (E)

[5] Available from International Organization for Standardization (ISO), 1 rue de Varembé, Case postale 56, CH-1211, Geneva 20, Switzerland, http://www.iso.ch.

[6] Available from AFNOR Association Française de Normalisation (AFNOR), 11, rue Francis de Pressensé, 93571 La Plaine Saint-Denis Cedex.

[7] Available from Japanese Standards Organization (JSA), 4-1-24 Akasaka Minato-Ku, Tokyo, 107-8440, Japan, http://www.jsa.or.ja.

NF X 11-690	Test Method for Particle Size Analysis by Gravity in a Moving Fluid (Levigation-Elutriation) (E)

SECTION 3—SURFACE AREA AND POROSITY MEASUREMENT METHODS

4.3 *Related Standards*:

4.3.1 *ASTM Standards:*[2]

ASTM B527	Test Method for Determination of Tap Density of Metallic Powders and Compounds
ASTM C20	Test Methods for Apparent Porosity, Water Absorption, Apparent Specific Gravity, and Bulk Density of Burned Refractory Brick and Shapes by Boiling Water
ASTM C1274	Test Method for Advanced Ceramic Specific Surface Area by Physical Adsorption
ASTM C1069	Test Method for Specific Surface Area of Alumina or Quartz by Nitrogen Adsorption
ASTM D1993	Test Method for Precipitated Silica-Surface Area By Multipoint BET Nitrogen Adsorption
ASTM D2752	Test Methods for Air Permeability of Asbestos Fibers
ASTM D2873	Test Method for Interior Porosity of Poly (Vinyl Chloride) (PVC) Resins by Mercury Intrusion Porosimetry
ASTM D3765	Test Method for Carbon Black—CTAB (Cetyltrimethylammonium Bromide) Surface Area
ASTM D3860	Practice for Determination of Adsorptive Capacity of Activated Carbon by Aqueous Phase Isotherm Technique
ASTM D3908	Test Method for Hydrogen Chemisorption on Supported Platinum on Alumina Catalysts and Catalyst Carriers by Volumetric Vacuum Method
ASTM D4222	Test Method for Determination of Nitrogen Adsorption and Desorption Isotherms of Catalysts By Static Volumetric Measurements
ASTM D4284	Test Method for Determining Pore Volume Distribution of Catalysts by Mercury Intrusion Porosimetry
ASTM D4365	Test Method for Determining Micropore Volume and Zeolite Area of a Catalyst
ASTM D4404	Test Method for Determination of Pore Volume and Pore Volume Distribution of Soil and Rock by Mercury Intrusion Porosimetry
ASTM D4567	Test Method for Single-Point Determination of Specific Surface Area of Catalysts Using Nitrogen Adsorption by Continuous Flow Method
ASTM D4641	Practice for Calculation of Pore Size Distribution of Catalysts from Nitrogen Desorption Isotherms
ASTM D4780	Test Method for Determination of Low Surface Area of Catalysts by Multipoint Krypton Adsorption
ASTM D4820	Test Methods for Carbon Black—Surface Area by Multipoint BET Nitrogen Adsorption
ASTM D4824	Test Method for Determination of Catalyst Acidity by Ammonia Chemisorption
ASTM D5816	Test Method for Carbon Black-External Surface Area by Multipoint Nitrogen Adsorption
ASTM E1294	Test Method for Pore Size Characteristics of Membrane Filters Using Automated Liquid Porosimeter

4.3.2 *British Standards:*[3]

BS 4359	Test Method for Determination of the Specific Surface Area of Powders
BS 4359: Part 1	Test Method for Recommendation for Gas Adsorption (BET)
BS 4359: Part 2	Test Method for Recommended Air Permeability
C1251-93	Guide for Determination of Surface Area

4.3.3 *German Standards:*[4]

DIN 66 126 T 1	Test Method for Determination of the Specific Surface Area of Disperse Solids by Permeability Technique Fundamentals
DIN 66 126 T 2	Test Method for Determination of the Specific Surface Area of Disperse Solids by Permeability Technique, Blaine Method and Apparatus
DIN 66 131	Test Method for Determination of the Specific Surface Area of Solids by Gas Adsorption According to the Method of Brunauer, Emmett and Teller (BET)
DIN 66 132	Test Method for Determination of the Specific Surface Area of Solids by Nitrogen Adsorption, Single Point Differential Method According to Haul and Dumbgen

4.3.4 *ISO Standards:*[5]

ISO 9277	Determination of the Specific Surface Area of Solids by Gas Adsorption — BET Method
ISO 10070	Test Method for Metallic Powders—Determination of Envelope-Specific Surface Area from Measurements of the Permeability to Air of a Powder Bed Under Steady-State Flow Conditions
ISO 15901-1	Pore Size Distribution and Porosity of Solid Materials Evaluation by Mercury Porosimetry and Gas Adsorption Part 1: Mercury Porosimetry
ISO 15901-2	Pore Size Distribution and Porosity of Solid Materials Evaluation by Mercury Porosimetry and Gas Adsorption Part 2: Analysis of Mesospores and Macropores by Gas Adsorption
ISO15901-3	Pore Size Distribution and Porosity of Solid Materials by Mercury Porosimetry and Gas Adsorption – Part 3: Analysis of Micropores by Gas Adsorption

4.3.5 *Japanese Standard:*[7]

JIS Z8830	Test Method for Determination of Specific Surface Area of Powders by Gas Adsorption

4.3.6 *French Standards:*[6]

NF X 11-601	Test Method for Sieving and Particle Size Analysis—Determination of the Specific/or Volumetric Surface of Powders by Permeametry—Lea and Nurse Method (E)
NF X 11-602	Test Method for Determination of the Specific Surface of Powders by Various Air Permeametry Methods (E)
NF X 11-621	Test Method for Determination of the Area Per Unit of Mass (Specific Surface) of Powders by Gas Adsorption—BET method: Volumetric Measurement by Adsorption of Nitrogen at Low Temperature (E)
NF X 11-622	Test Method for Determination of the Area Per Unit of Mass (Specific Surface) of Powders by Gas Adsorption—Variation of the Basic Method (E)
NF ISO 9277	Determination of the Specific Surface Area of Solids by Gas Adsorption using the BET Method

SECTION 4—SIEVING METHODS

4.4 *Related Standards*:

4.4.1 *ASTM Standards:*[2]

ASTM B214	Test Method for Sieve Analysis of Metal Powders
ASTM C92	Test Methods for Sieve Analysis and Water Content of Refractory Materials
ASTM C110	Test Methods for Physical Testing of Quicklime, Hydrated Lime, and Limestone
ASTM C117	Test Method for Materials Finer Than 75 Micrometre (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C125	Terminology Relating to Concrete and Concrete Aggregates
ASTM C136	Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C141	Specification for Hydraulic Hydrated Lime for Structural Purposes
ASTM C142	Test Method for Clay Lumps and Friable Particles in Aggregates
ASTM C144	Specification for Aggregate for Masonry Mortar
ASTM C184	Test Method for Fineness of Hydraulic Cement by the 150-micrometre (No. 100) and 75-Micrometre (No. 200) Sieves
ASTM C285	Test Methods for Sieve Analysis of Wet-Milled and Dry-Milled Porcelain Enamel
ASTM C325	Test Method for Wet Sieve Analysis of Ceramic Whiteware Clays
ASTM C331	Specification for Lightweight Aggregates for Concrete Masonry Units
ASTM C371	Test Method for Wire-Cloth Sieve Analysis of Nonplastic Ceramic Materials
ASTM C429	Test Method for Sieve Analysis of Raw Materials for Glass Manufacture
ASTM C430	Test Method for Fineness of Hydraulic Cement by the 45-micrometre (No. 325) Sieve
ASTM C516	Specification for Vermiculite Loose Fill Thermal Insulation
ASTM C549	Specifications for Perlite Loose Fill Insulation
ASTM C778	Specification for Standard Sand

ASTM C786	Test Method for Fineness of Hydraulic Cement and Raw Materials by the 300-μm (No. 50), 150-μm (No. 100), and 75-μm (No. 200) Sieves by Wet Methods
ASTM C925	Test Method for Precision Electroformed Wet Sieve Analysis of Nonplastic Ceramic Powders
ASTM D185	Test Method for Coarse Particles in Pigments, Pastes, Paints
ASTM D197	Test Method for Sampling and Fineness Test of Pulverized Coal
ASTM D244	Test Methods and Practices for Emulsified Asphalts
ASTM D293	Test Method for the Sieve Analysis of Coke
ASTM D409	Test Method for Grindability of Coal by the Hardgrove-Machine Method
ASTM D421	Practice for Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants
ASTM D422	Test Method for Particle-Size Analysis of Soils
ASTM D422	Test Method for Particle-Size Analysis of Soils
ASTM D451	Test Method for Sieve Analysis of Granular Mineral Surfacing for Asphalt Roofing Products
ASTM D452	Test Method for Sieve Analysis of Surfacing for Asphalt Roofing Products
ASTM D480	Test Methods for Sampling and Testing of Flaked Aluminum Powders and Pastes
ASTM D502	Test Method for Particle Size of Soaps and Other Detergents
ASTM D546	Test Method for Sieve Analysis of Mineral Filler for Bituminous Paving Mixtures
ASTM D718	Test Method for Analysis of Aluminum Silicate Pigment
ASTM D1140	Test Methods for Amount of Material in Soils Finer than No. 200 (75-m) Sieve
ASTM D1214	Test Method for Sieve Analysis of Glass Spheres
ASTM D1457	Specifications for PTFE Molding and Extrusion Materials
ASTM D1508	Test Method for Carbon Black, Pelleted Fines and Attrition
ASTM D1511	Test Method for Carbon Black—Pellet Size Distribution
ASTM D1514	Test Method for Carbon Black—Sieve Residue
ASTM D1921	Test Method for Particle Size (Sieve Analysis) of Plastic Materials
ASTM D2187	Test Methods for Physical and Chemical Properties of Particulate Ion-Exchange Resins
ASTM D2217	Test Method for Wet Preparation of Soil Samples for Particle Size Analysis and Determination of Soil Constants
ASTM D2419	Test Method for Sand Equivalent Value of Soils and Fine Aggregate
ASTM D2487	Test Method for Classification of Soils for Engineering Purposes
ASTM D2589	Test Method for Bauer-McNett Wet Classification of Asbestos Fiber
ASTM D2772	Test Method for Sieve Analysis of Electrical Grade Magnesium Oxide
ASTM D2862	Test Method for Particle Size Distribution of Granular Activated Carbon
ASTM D2947	Test Method for Screen analysis of Asbestos Fibers
ASTM D4749	Test Method for Sieve Analysis of Coal
ASTM E11	Specification for Wire-Cloth Sieves for Testing Purposes
ASTM E161	Specification for Precision Electroformed Sieves
ASTM E276	Test Method for Particle Size or Screen Analysis at No. 4 (4.75 mm) Sieve and Finer for Metal Bearing Ores and Related Materials
ASTM E323	Test Method for Perforated-Plate Sieves for Testing Purposes
ASTM E389	Test Method for Particle Size or Screen Analysis at No. 4 (4.7 mm) Sieve and Coarser for Metal–Bearing Ores and Related Materials
ASTM E828	Test Method for Designating the Size of RDF-3 from its Sieve Analysis

4.4.2 *German Standards:*[4]

DIN 66 165 T1	Particle Size Analysis, Sieving Analysis, Fundamentals
DIN 66 165 T2	Particle Size Analysis, Sieving Analysis, Procedure
DIN/ISO 3310-1	Test Sieves Technical Requirements and Testing: Test Sieves of Metal Wire Cloth
DIN/ISO 3310-2	Test Sieves of Perforated Metal Plate
DIN/ISO 3310-3	Test Sieves of Electroformed Sheets

4.4.3 *ISO Standards:*[5]

ISO 2591-1	Test Sieving -Part 1—Methods Using Test Sieves of Woven Wire Cloth and Perforated Metal Plate
ISO 4497	Metallic Powders—Determination of Particle Size by Dry Sieving

4.4.4 *Japanese Standards:*[7]

JIS Z8800	Test Sieves with Electroformed Sheet
JIS Z8801	Test Sieves
JIS Z8815	Test Sieving

4.4.5 *Metal Powders Industry Standard:*[8]

MPIF 05	Determination of Sieve Analysis of Metal Powders

4.4.6 *French Standards:*[6]

NF E81-061	Sieves and Sieving—Punching and Stamping—Aperture and Pitch of Perforated Plates with Round Holes and Square Holes
NF EN 933-2	Testing for Determination of the Granulates Geometric Characteristics—Part 2: Determination of the Granularity (Distribution) Curve—Test Sieves and Nominal Size Openings
NF ISO 2591-1	Test Sieving—Part 1: Methods Using Test Sieves of Woven Wire Cloth and Perforated Metal Plate (Classification Index: X 11-507)
NF ISO 14315	Industrial Wire Screens — Technical Requirements and Testing
NF ISO 2194	Industrial Screens- Woven Wire Cloth, Perforated Plate and Electroformed Sheet-Designation and Nominal Sizes of Openings
NF ISO 3310-2	Test Sieves—Technical Requirements and Testing—Part 2: Test Sieves of Perforated Metal Plate
NF ISO 3310-3	Test Sieves—Technical Requirements and Testing — Part 3: Test Sieves of Electroformed Sheets
NF ISO 4782	Metal Wire for Industrial Metal Screens and Woven Wire Cloth
NF ISO 565	Test Sieves—Metal Wire Cloth, Perforated Metal Plate and Electroformed Sheet — Nominal Sizes of Openings
NF ISO 9044	Industrial Woven Wire Cloth—Technical Requirements and Testing
NF X 11-500	Sieves and Sieving—Terminology
NF X 11-504	Metal Wire Cloth and Perforated Plate For Test Sieves—Technical Requirements and Verifications (E)
NF X 11-508	Sieves and Sieving—Correspondence Table for Woven Metal Wire Cloth for Test Sieves (E)
NF X 11-510	Sieves and Sieving—Wire Gauze with Square Apertures Made from Annealed Round Wire for Industrial Use—Wire Diameters
NF X 11-511	Sieves and Sieving—Preformed Wire Gauze With Square Apertures Made from High Tensile Steel Round Wire for Industrial Sieving
NF X 11-512	Sieves and Sieving—Vocabulary Relating to Defects in Woven Wire Cloths (E)
NF X 11-515	Sieves and Sieving—Hollander Metal Weaves—Plain Weave Weft
NF X 11-516	Sieves and Sieving—Industrial Wire Screens—Tolerances
NF X 11-519	Sieves and Sieving—Industrial Wire Screens—Number of Blemishes
NF X 11-640	Test Method for Particle Size Analysis—Particle Size Analysis of Fine Powders with Air-Jet Sieving Device (E)
NF X 11-642	Test Method for Particle Size Analysis—Sieving in Liquid Media of Powders of Particle Size Smaller than 200 Micrometers (E)

SECTION 5—ELECTRICAL SENSING METHODS

4.5 *Related Standards*:

4.5.1 *ASTM Standards:*[2]

ASTM C690	Test Method for Particle Size Distribution of Alumina or Quartz by Electric Sensing Zone Technique

[8] Available from Metal Powder Industries Federation (MPIF), 105 College Rd. East, Princeton, NJ 08540, http://www.mpif.org.

ASTM D4438	Test Method for Particle Size Distribution of Catalytic Material by Electronic Counting
ASTM F662	Test Method for Measurement of Particle Count and Size Distribution in Batch Samples for Filter Evaluation using an Electrical Resistance Particle Counter

4.5.2 *British Standard:*[3]

BS 3406: Part 5	Recommendation for Electrical Sensing Zone Method (the Coulter Principle)

4.5.3 *French Standard:*[6]

NF X 11-670	Test Method for Particle Size Analysis in an Electrolyte Suspension Using a Resistance Variation Counter

4.5.4 *ISO Standard:*[5]

ISO 13319	Determination of Particle Size Distributions – Electrical Sensing Zone Method
ISO 15900	Determination of Particle Size Distributions—Differential Electrical Mobility Analysis for Aerosol Particles

SECTION 6—LASER DIFFRACTION METHODS

4.6 *Related Standards*:

4.6.1 *ASTM Standards:*[2]

ASTM B822	Test Method for Particle Size Distribution of Metal Powders and Related Compounds by Light Scattering
ASTM D4464	Test Method for Particle Size Distribution of Catalytic Material by Laser Light Scattering
ASTM E1260	Test Method for Determining Liquid Drop Size Characteristics in a Spray Using Optical Non-Imaging Light-Scattering Instruments
ASTM E1458	Test Method for Calibration Verification of Laser Diffraction Particle Sizing Instruments Using Photomask Reticles

4.6.2 *French Standard:*[6]

NF X 11-666	Test Method for Particle Size Analysis—Determination of Particle Size of Powders—Optical Microscope Method (E)

4.6.3 *ISO Standards:*[5]

ISO 13320	Particle Size Analysis— Laser Diffraction Methods — General Principles

SECTION 7—PHOTON CORRELATION SPECTROSCOPY METHODS

4.7 *Related Standards*:

4.7.1 *ASTM Standard:*[5]

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

4.7.2 *ISO Standards:*[5]

ISO 13321	Particle Size Analysis – Photon Correlation Spectroscopy
ISO/WD 13321-2	Particle Size Analysis—Photon Correlation Spectroscopy Part 2: Validation of Inversion Procedures
ISO 22412	Particle Size Analysis—Dynamic Light Scattering (DLS)

4.7.3 *French Standard:*[6]

NF ISO 13321	Test Method for Particle Size Analysis—Photon Correlation Spectroscopy

SECTION 8—IMAGE ANALYSIS METHODS

4.8 *Related Standards*:

4.8.1 *ASTM Standards:*[2]

ASTM F312	Test Methods for Microscopical Sizing and Counting Particles from Aerospace Fluids on Membrane Filters
ASTM F661	Practice for Particle Count and Size Distribution Measurement in Batch Samples for Filter Evaluation Using an Optical Particle Counter
ASTM F662	Test Method for Measurement of Particle Count and Size Distribution in Batch Samples for Filter Evaluation

4.8.2 *British Standard:*[3]

BS 3406: Part 4	Optical Microscope Method

4.8.3 *ISO Standards:*[5]

ISO 13322–1	Particle Size Analysis—Image Analysis Methods—Part 1: Static image analysis methods
ISO 13322–2	Particle Size Analysis—Image Analysis Methods—Part 2: Dynamic Image Analysis Methods

4.8.4 *French Standards:*[6]

NF X 11-660	Test Method for Grain Size Analysis Using Optical Microscopes—General Details of Microscope (E)
NF X 11-661	Test Method for Particle Size Analysis—Determination of Particle Size of Powders—Optical Microscope (E)
NF X 11-696	Test Method for Particle Size Analysis Through Image Analysis

4.8.5 *German Standard:*[9]

VDI 2269	Microscopic Investigation of Particles Survey

SECTION 9—SINGLE PARTICLE LIGHT INTERACTION METHODS

4.9 *Related Standards*:

4.9.1 *ASTM Standards:*[2]

ASTM F25	Test Method for Sizing and Counting Airborne Particulate Contamination in Cleanrooms and Other Dust-Controlled Areas
ASTM F658	Practice for Calibration of a Liquid-Borne Particle Counter Using an Optical System Based Upon Light Extinction
ASTM F795	Practice for Determining the Performance of a Filter Medium Employing a Single Pass, Constant Rate, Liquid Test

4.9.2 *British Standard:*

BS 3406: Part 7	Recommendations for Single Particle Light Interaction Methods[3]

4.9.3 *ISO Standards:*[5]

ISO 21501–1	Determination of Particle Size Distribution – Single Particle Light Interaction Methods – Part1: Light Scattering Aerosol Spectrometer
ISO 21501–2	Determination of Particle Size Distribution—Single Particle Light Interaction Methods—Part 2: Light Scattering Liquid-Borne Particle Counter
ISO 21501–3	Determination of Particle Size Distribution—Single Particle Light Interaction Methods—Part 3: Light Extinction Liquid-Borne Particle Counter
ISO 21501–4	Determination of Particle Size Distribution—Single Particle Light Interaction Methods—Part 4: Light Scattering Airborne Particle Counter for Clean Spaces

SECTION 10—SMALL ANGLE X-RAY SCATTERING METHOD

4.10 *Related Standards*:

4.10.1 *ISO Standard:*[5]

ISO/TS 13762	Particle Size Analysis—Small Angle X-Ray Scattering Methods

SECTION 11—SAMPLING METHODS

4.11 *Related Standards*:

4.11.1 *ANSI Standard:*[10]

ANSI B74.6	Procedure for Sampling of Abrasive Grains, (R 1982)

4.11.2 *ASTM Standards:*[2]

[9] Available from The Association of German Engineers (VDI) International, P.O. Box 10 11 39, 40002 Duesseldorf.

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

ASTM B215	Practices for Sampling Metal Powders
ASTM B821	Guide for Liquid Dispersion of Metal Powders and Related Compounds for Particle Size Analysis
ASTM B859	Test Method for De-Agglomeration of Refractory Metal Powders and Their Compounds Prior to Particle Size Analysis
ASTM C322	Test Method for Sampling Ceramic Whiteware Clays
ASTM D75	Practice for Sampling Aggregates
ASTM D1045	Test Method for Sampling and Testing Plasticizers Used in Plastics
ASTM D2755	Test Method for Sampling and Reduction to Test Weight of Electrical Grade Magnesium Oxide
ASTM D3370	Practices for Sampling Water from Closed Conduits
ASTM F318	Practice for Sampling Airborne Particulate Contamination in Cleanrooms for Handling Aerospace Fluids

4.11.3 *British Standard:*[3]

BS 3406: Part 1	Guide to Powder Sampling

4.11.4 *ISO Standards:*[5]

ISO 3954	Test Method for Sampling Powders for Powder Metallurgical Purpose
ISO 14488	Particulate Materials—Sampling and Sample Splitting for the Determination of Particulate Properties
ISO 14887	Sample Preparation—Dispersing Procedures for Powders in Liquids

4.11.5 *Metal Powders Industry Standard:*[8]

MPIF 01	Test Method for Sampling Finished Lots of Metal Powders

4.11.6 *French Standards:*[6]

NF X 11-693	Test Method for Particle Size Analysis—Liquid Suspending Media and Dispersing Agents (E)
NF X 14-001	Test Method for Sampling Equipment—Conical Sampler

SECTION 12—GENERAL METHODS AND INFORMATION

4.12 *Related Standards*:

4.12.1 *ASTM Standards:*[2]

ASTM B330	Test Method for Fisher Number of Metal Powders and Related Compounds
ASTM C604	Test Method for True Specific Gravity of Refractory Materials by Gas-Comparison Pycnometer
ASTM D2638	Test Method for Real Density of Calcined Petroleum Coke by Helium Pycnometer
ASTM D3037	Test Method for Carbon Black—Surface Area by Nitrogen Adsorption
ASTM D4164	Test Method for Mechanically Tapped Packing Density of Formed Catalyst and Catalyst Carriers
ASTM D4179	Test Method for Single Pellet Crush Strength of Formed Catalyst Shapes
ASTM D4781	Test Method for Mechanically Tapped Packing Density of Fine Catalyst Particles and Catalyst Carrier Particles
ASTM D5550	Test Method for Specific Gravity of Solid Soils by Gas Pycnometer
ASTM D6128	Test Method for Shear Testing of Bulk Solids Using the Jenike Shear Cell
ASTM D6393	Test Method for Bulk Solids Characterization by Carr Indices
ASTM D6682	Test Method for Measuring Shear Stresses of Powders Using Peschl Rotational Split Level Shear Tester
ASTM D6683	Test Method for Measuring Bulk Density Values of Powders and Other Bulk Solids
ASTM D6773	Shear Test Method for Bulk Solids Using the Schulze Ring Shear Tester
ASTM E177	Practice for Use of the Terms Precision and Bias in ASTM Test Methods
ASTM E1620	Terminology Relating to Liquid Particles and Atomization
ASTM E691	Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method
ASTM F660	Practice for Comparing Particle Size in the Use of Alternative Types of Particle Counters

4.12.2 *British Standard:*[3]

BS 2955	Glossary of Terms Relating to Powders

4.12.3 *German Standards:*[4]

DIN 66 160	Analysis of Disperse Systems, Concepts
DIN 66 161	Particle Size Analysis, Formula, Symbols, Units

4.12.4 *ISO Standards:*[5]

ISO 565	Test Sieves—Metal Wire Cloth, Perforated Metal Plate and Electroformed Sheet—Nominal Sizes of Openings
ISO 2395 (E/F)	Test Sieves and Test Sieving—Vocabulary
ISO 3310	Test Sieves—Technical Requirements and Testing
ISO 3310-1	Part 1: Test Sieves of Metal Wire Cloth
ISO 3310-2	Part 2: Test Sieves of Perforated Metal Plate
ISO 3310-3	Part 3: Test Sieves of Electroformed Sheets
ISO 9045 (E/F)	Industrial Screens and Screening—Vocabulary
ISO 20998–1	Measurement and Characterization of Particles by Acoustic Methods – Part 1: Concepts and Procedures in Ultrasonic Attenuation Spectroscopy

4.12.5 *Metal Powders Industry Standard:*[8]

MPIF 32	Test Method for Determination of Average Particle Size of Metal Powders Using the Fisher Subsieve Sizer

4.12.6 *French Standards:*[6]

NF X 11-630	Particle Size Analysis—Vocabulary (E)
NF X 11-695	Particle Size Analysis—Designation of Sizing Methods

4.12.7 *German Standard:*[9]

VDI 3491	Test Method for Measurement of Particles—Criteria and Test Methods for Methods and Instruments Designed for the Determination of Particles in Gases; Terms and Definitions

5. Keywords

5.1 centrifugal sedimentation; classification; density; electrical sensing; gravity sedimentation; image analysis; laser diffraction; particle size; particle characterization; photon correlation spectroscopy; pore size distribution; porosity; representation and treatment of data; sieving; single particle light interaction; small angle x-ray scattering and sampling; surface area measurement