Designation: E 1919 – 03

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

This standard is issued under the fixed designation E 1919; 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, Vocabulary, and Information

2. Terminology

2.1 *Abbreviations:Abbreviations:*

ASME—American Society of Mechanical Engineers
ASTM—American Society for Testing and Materials
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*:

ASTM E 177	Practice for Use of the Terms Precision and Bias in ASTM Test Methods[2]
ASTM E 799	Practice for Determining Data Criteria and Processing for Liquid Drop Size Analysis[2]
ASTM E 1617	Practice for Reporting Particle Size Characterization Data[2]
ASTM F 658	Practice for Defining Size Calibration, Resolution, and Counting Accuracy of a Liquid-Borne Particle Counter Using Near-Monodisperse Spherical Particulate Material[2]

4.1.2 *British Standard*:

BS 3406	Test Method for the Determination of Particle Size Distribution[3]

4.1.3 *German Standards*:

[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 American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-22959.

[3] Available from British Standard Specification, 389 Chiswick High Road, London W4 4AL.

DIN 66 141	Representation of (grain) Particle Size Distributions, Basic Standard[4]
DIN 66 142 T 1	Representation and Identification of Separated Fractions of Dispersed Matter; Fundamentals[4]
DIN 66 142 T 2	Representation and Identification of Separated Fractions of Dispersed Matter, Application to Analytical Separations[4]
DIN 66 142 T 3	Representation and Identification of Separated Fractions to Dispersed Matter, Selection and Determination of Parameters of[4]
DIN 66 143	Representation of (Grain) Particle Size Distributions, Power Function Grid[4]
DIN 66 144	Representation of (Grain) Particle Size Distributions, Logarithmic Gaussian Grid[4]
DIN 66 145	Representation of (Grain) Particle Size Distributions; RRSB Grid[4]
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*:

ISO 9276-1	Representation of Results of Particle Size Analysis - Part 1 - Graphical Representation[5]
ISO 9276-2	Representation of Results of Particle Size Analysis—Part 2: Calculation of Average Particle Sizes/Diameters and Moments from Particle Size Distributions[5]
ISO/CD 9276-3	Representation of Results of Particle Size Analysis—Part 3: Fitting of an Experimental Cumulative Curve to a Reference Model[5]
ISO 9276-4	Representation of Results of Particle Size Analysis—Part 4: Characterization of a Classification Process Used for Particle Size Analysis[5]
ISO/CD 9276-5	Representation of Results of Particle Size Analysis—Part 5: Validation of Calculations Relating to Particle Size Analyses Using the Logarithmic Normal Probability Distribution[5]

4.1.5 *French Standards*:

NF X 11-632	Particle Size Analysis—Expression of Experimental Results of Particle Size Analysis (E)[6]
NF X 11-634	Particle Size Analysis—Characterization of the Size and Form of the Elements of a Granular Population[6]
NF X 11-635	Particle Size Analysis—Representation of Particle Size Distributions - Reference Models[6]
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[6]

SECTION 2—SEDIMENTATION, CLASSIFICATION, GRAVITY AND CENTRIFUGAL METHODS

4.2 *Related Standards*:

4.2.1 *ASTM Standards*:

ASTM B 330	Test Method for Average Particle Size of Powders of Refractory Metals and Their Compounds by the Fisher Sub-Sieve Sizer[2]
ASTM B 430	Test Method for Particle Size Distribution of Refractory Metal Powders and Related Compounds by Turbidimetry[2]
ASTM B 761	Test Method for Particle Size Distribution of Metal Powders Related Compounds by X-Ray Monitoring of Gravity Sedimentation[2]
ASTM C 721	Test Method for Average Particle Size of Alumina and Silica Powders by Air Permeability[2]
ASTM C 775	Test Method for Particle-Size Analysis of Whiteware Clays[2]
ASTM C 958	Test Method for Particle Size Distribution of Alumina or Quartz by X-Ray Monitoring of Gravity Sedimentation[2]
ASTM C 1282	Test Method for Determining the Particle Size Distribution of Advanced Ceramics by Centrifugal Photosedimentation[2]

4.2.2 *British Standards*:

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

4.2.3 *German Standards*:

DIN 66 111	Particle Size Analysis; Sedimentation Analysis; Principles[4]
DIN 66 111 Bbl.1	Particle Size Analysis; Sedimentation Analysis; Principles; Evaluation Equations for Determination of Quantities in the Field of Centrigual Force[4]
DIN 66 115	Test Method for Particle Size Analysis, Sedimentation Analysis in the Gravitational Field[4]
DIN 66 116	Grain (particle) Size Analysis; Sedimentation Analysis in the Gravitational Field, Sedimentation Balance[4]
DIN 66 118	Particle Size Analysis, Size Analysis by Air Classification, Fundamentals[4]
DIN 66 119	Particle Size Analysis, Size Analysis by Air Classification with Gravitation Counterflow[4]
DIN 66 120	Particle Size Analysis, Size Analysis by Air Classification with Centrifugal Counterflow Classifier[4]

4.2.4 *ISO Standard*:

ISO 10076	Metallic Powders - Determination of Particle Size Distribution by Gravitational Sedimentation in a Liquid and Attenuation Measurement[5]
ISO 13317-1	Determination of Particle Size Distribution by Gravitational Liquid Sedimentation Methods Part 1: General Principles and Guidelines[5]
ISO 13317-2	Determination of Particle Size Distribution by Gravitational Liquid Sedimentation Methods Part 2: Pipette Methods (Fixed and Variable Positions)[5]
ISO 13317-3	Determination of Particle Size Distribution by Gravitational Liquid Sedimentation Methods Part 3: X-Ray Method[5]
ISO 13318-1	Determination of Particle Size Distribution by Centrifugal Liquid Sedimentation Methods Part 1: General Principles and Guidelines[5]
ISO 13318-2	Determination of Particle Size Distribution by Centrifugal Liquid Sedimentation Methods Part 4: Photocentrifugal Method[5]
ISO/FDIS 13318-3	Determination of Particle Size Distribution by Centrifugal Liquid Sedimentation Methods Part 3: Centrifugal X-Ray Method[5]
ISO/WD 13318-4	Determination of Particle Size Distribution by Centrifugal Liquid Sedimentation Methods Part 2: Centrifugal Pipette Method[5]

4.2.5 *Japanese Standards*:

JIS Z8820	General Rules for the Determination of Particle Size Distribution by Sedimentation in Liquid[7]
JIS Z8821	Determination of Particle Size Distribution by the Sedimentation in Liquid Using the Pipette Apparatus[7]
JIS Z8822	Determination of Particle Size Distribution by the Weight of Sedimentation in Liquid[7]

4.2.6 *French Standards*:

NF X 11-680	Test Method for Particle Size Analysis—Separation by Fluids - Particle Size Analysis by Gravity Sedimentation in a Liquid Medium (E)[6]
NF X 11-681	Test Method for Particle Size Analysis—Particle Size Analysis by Gravity Sedimentation in a Liquid Medium (E)[6]
NF X 11-682	Test Method for Particle Size Analysis—Particle Size Analysis by Gravitational Liquid Sedimentation - Photosedimentation Technique (E)[6]

[4] Available from Deutsches Institut fur Normung; German Standard Institution, Burggrafenstra Be 6, 10787 Berlin.

[5] Available from International Organization for Standardization, 1 rue de Varembe, Case Postale 56, CH-1211 Geneve 20, Switzerland.

[6] Available from Normalization Francaise (AFNOR) French Standards, Tour Europe; Cedex 7; 92049 Paris-LaDefense; France.

[7] Available from Japanese Standards Association/Japanese Industrial Standard, 4-1-24, Akosaka; Minato-Ku, Tokyo 107.

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)[6]
NF X 11-684	Test Method for Particle Size Analysis—Particle Size Analysis by Cumulative Sedimentation in a Static Liquid - Sedimentation Balance Method[6]
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)[6]
NF X 11-690	Test Method for Particle Size Analysis by Gravity in a Moving Fluid (Levigation-Elutriation) (E)[6]

SECTION 3—SURFACE AREA AND POROSITY MEASUREMENT METHODS

4.3 *Related Standards*:

4.3.1 *ASTM Standards*:

ASTM B 527	Test Method for Determination of Tap Density of Metallic Powders and Compounds[2]
ASTM C 20	Test Methods for Apparent Porosity, Water Absorption, Apparent Specific Gravity, and Bulk Density of Burned Refractory Brick and Shapes by Boiling Water[2]
ASTM C 1274	Test Method for Advanced Ceramic Specific Surface Area by Physical Adsorption[2]
ASTM C 1069	Test Method for Specific Surface Area of Alumina or Quartz by Nitrogen Adsorption[2]
ASTM D 1993	Test Method for Precipitated Silica-SurfaceArea By Multipoint BET Nitrogen Adsorption[2]
ASTM D 2752	Test Methods for Air Permeability of Asbestos Fibers[2]
ASTM D 2873	Test Method for Interior Porosity of Poly (Vinyl Chloride) (PVC) Resins by Mercury Intrusion Porosimetry[2]
ASTM D 3765	Test Method for Carbon Black-CTAB (Cetyltrimethylammonium Bromide) Surface Area[2]
ASTM D 3860	Practice for Determination of Adsorptive Capacity of Carbon by Isotherm Technique[2]
ASTM D 3908	Test Method for Hydrogen Chemisorption on Supported Platinum on Alumina Catalysts by Volumetric Vacuum Method[2]
ASTM D 4222	Test Method for Determining Nitrogen Adsorption and Desorption Isotherms of Catalysts by Static Volumetric Measurement[2]
ASTM D 4284	Test Method for Determining Pore Volume Distribution of Catalysts by Mercury Intrusion Porosimetry[2]
ASTM D 4365	Test Method for Determining Micropore Volume Zeolite Area of a Catalyst[2]
ASTM D 4404	Test Method for Determination of Pore Volume and Pore Volume Distribution of Soil and Rock by Mercury Intrusion Porosimetry[2]
ASTM D 4567	Test Method for Single-Point Determination of Specific Surface Area of Catalysts Using Nitrogen Adsorption by Continuous Flow Method[2]
ASTM D 4641	Practice for Calculation of Pore Size Distribution of Catalysts from Nitrogen Desorption Isotherms[2]
ASTM D 4780	Test Method for Determination of Low Surface Area of Catalysts by Multipoint Krypton Adsorption[2]
ASTM D 4820	Test Methods for Carbon Black—Surface Area by Multipoint BET Nitrogen Adsorption[2]
ASTM D 4824	Test Method for Determination of Catalyst Acidity by Ammonia Chemisorption[2]
ASTM D 5816	Test Method for Carbon Black-External Surface Area by Multipoint Nitrogen Adsorption[2]
ASTM E 1294	Test Method for Pore Size Characteristics of Membrane Filters Using Automated Liquid Porosimeter[2]

4.3.2 *British Standards*:

BS 4359	Test Method for Determination of the Specific Surface Area of Powders[3]
BS 4359: Part 1	Test Method for Recommendation for Gas Adsorption (BET)[3]
BS 4359: Part 2	Test Method for Recommended Air Permeability[3]
C1251-93	Guide for Determination of Surface Area[3]

4.3.3 *German Standards*:

DIN 66 126 T 1	Test Method for Determination of the Specific Surface Area of Disperse Solids by Permeability Technique Fundamentals[4]
DIN 66 126 T 2	Test Method for Determination of the Specific Surface Area of Disperse Solids by Permeability Technique, Blaine Method and Apparatus[4]
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)[4]
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]

4.3.4 *ISO Standards*:

ISO 9277	Test Method for Determination of the Specific Surface Area of Solids by Gas Adsorption Using the BET Method[5]
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[5]
ISO/CD 15901-1	Pore Size Distribution and Porosity of Solid Materials Evaluation by Mercury Porosimetry and Gas Adsorption Part 1: Mercury Porsimetry[5]
ISO/CD 15901-2	Pore Size Distribution and Porosity of Solid Materials Evaluation by Mercury Porosimetry and Gas Adsorption Part 2: Analysis of Meso- and Macro-Pores[5]
ISO/WD 15901-3	Pore Size Distribution and Porosity of Solid Materials Evaluation by Mercury Porosimetry and Gas Adsorption Part 3: Analysis of Micro-Pores by Gas Adsorption[5]

4.3.5 *Japanese Standard*:

JIS Z8830	Test Method for Determination of Specific Surface Area of Powders by Gas Adsorption[7]

4.3.6 *French Standards*:

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)[6]
NF X 11-602	Test Method for Determination of the Specific Surface of Powders by Various Air Permeametry Methods (E)[6]
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)[6]
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)[6]
NF ISO 9277	Determination of the Specific Surface Area of Solids by Gas Adsorption using the BET Method[6]

SECTION 4—SIEVING METHODS

4.4 *Related Standards*:

4.4.1 *ASTM Standards*:

ASTM B 214	Test Method for Sieve Analysis of Granular Metal Powders[2]
ASTM C 92	Test Methods for Sieve Analysis and Water Content of Refractory Materials[2]
ASTM C 110	Test Methods for Physical Testing of Quicklime, Hydrated Lime, and Limestone[2]
ASTM C 117	Test Method for Materials Finer Than 75 Micrometre (No. 200) Sieve in Mineral Aggregates by Washing[2]
ASTM C 125	Terminology Relating to Concrete and Concrete Aggregates[2]
ASTM C 136	Test Method for Sieve Analysis of Fine and Coarse Aggregates[2]
ASTM C 141	Specification for Hydraulic Hydrated Lime for Structural Purposes[2]
ASTM C 142	Test Method for Clay Lumps and Friable Particles in Aggregates[2]
ASTM C 144	Specification for Aggregate for Masonry Mortar[2]
ASTM C 184	Test Method for Fineness of Hydraulic Cement by the 150-micrometre (No. 100) and 75-Micrometre (No. 200) Sieves[2]

ASTM C 285	Test Methods for Sieve Analysis of Wet-Milled and Dry-Milled Porcelain Enamel[2]
ASTM C 325	Test Method for Wet Sieve Analysis of Ceramic Whiteware Clays[2]
ASTM C 331	Specification for Lightweight Aggregates for Concrete Masonry Units[2]
ASTM C 371	Test Method for Wire-Cloth Sieve Analysis of Nonplastic Ceramic Materials[2]
ASTM C 429	Test Method for Sieve Analysis of Raw Materials for Glass Manufacture[2]
ASTM C 430	Test Method for Fineness of Hydraulic Cement by the 45-micrometre (No. 325) Sieve[2]
ASTM C 516	Specification for Vermiculite Loose Fill Thermal Insulation[2]
ASTM C 549	Specifications for Perlite Loose Fill Insulation[2]
ASTM C 775	Test Method for Particle Size Analysis of Whiteware Clays[2]
ASTM C 778	Specification for Standard Sand[2]
ASTM C 786	Test Method for Fineness of Hydraulic Cement[2]
ASTM C 925	Test Method for Precision Electroformed Wet Sieve Analysis of Nonplastic Ceramic Powders[2]
ASTM D 185	Test Method for Coarse Particles in Pigments, Pastes, Paints[2]
ASTM D 197	Test Method for Sampling and Fineness Test of Pulverized Coal[2]
ASTM D 244	Testing Emulsified Asphalts[2]
ASTM D 293	Test Method for Particle Size of Coke by Sieve Analysis[2]
ASTM D 409	Test Method for Grindability of Coal by Hardgrove Machine[2]
ASTM D 421	Test Method for Dry Preparation of Soil Samples for Particle Size Analysis and Determination of Soil Constants[2]
ASTM D 422	Test Method for Particle Size Analysis of Soils[2]
ASTM D 451	Test Method for Sieve Analysis of Granular Mineral Surfacing for Asphalt Roofing Products[2]
ASTM D 452	Test Method for Sieve Analysis of Nongranular Mineral Surfacing for Asphalt Roofing and Shingles[2]
ASTM D 480	Test Method for Sampling and Testing Aluminum Powder and Paste[2]
ASTM D 502	Test Method for Particle Size of Soaps and Other Detergents[2]
ASTM D 546	Test Method for Sieve Analysis of Mineral Filler for Road and Paving Materials[2]
ASTM D 718	Test Method for Analysis of Aluminum Silicate Pigment[2]
ASTM D 1140	Test Method for Amount of Material in Soils Finer Than the No. 200 Sieve[2]
ASTM D 1214	Test Method for Sieve Analysis of Glass Spheres[2]
ASTM D 1457	Specifications for PTFE Molding and Extrusion Materials[2]
ASTM D 1508	Test Method for Carbon Black, Pelleted Fines Content[2]
ASTM D 1511	Test Method for Carbon Black, Pellet Size Distribution[2]
ASTM D 1514	Test Method for Sieve Residue from Carbon Black[2]
ASTM D 1705	Test Method for Particle Size Analysis of Powdered Vinyl Chloride Polymers and Copolymers[2]
ASTM D 1921	Test Method for Particle Size (Sieve Analysis) of Plastic Materials[2]
ASTM D 2187	Test Methods for Physical and Chemical Properties of Ion-Exchange Resins[2]
ASTM D 2217	Test Method for Wet Preparation of Soil Samples for Particle Size Analysis and Determination of Soil Constants[2]
ASTM D 2419	Test Method for Sand Equivalent Value of Soils and Fine Aggregate[2]
ASTM D 2487	Test Method for Classification of Soils for Engineering Purposes[2]
ASTM D 2589	Test Method for Bauer-McNett Wet Classification of Asbestos Fiber[2]
ASTM D 2772	Test Method for Sieve Analysis of Electrical Grade Magnesium Oxide[2]
ASTM D 2862	Test Method for Particle Size Distribution of Granular Activated Carbon[2]
ASTM D 2947	Test Method for Screen analysis of Asbestos Fibers.[2]
ASTM D 4749	Test Method for Sieve Analysis of Coal[2]
ASTM E 11	Specification for Wire-Cloth Sieves for Testing Purposes[2]
ASTM E 161	Specification for Precision Electroformed Sieves[2]
ASTM E 276	Test Method for Particle Size or Screen Analysis at No. 4 (4.75 mm) Sieve and Finer for Metal Bearing Ores and Related Materials[2]
ASTM E 323	Test Method for Perforated-Plate Sieves for Testing Purposes[2]
ASTM E 389	Test Method for Particle Size or Screen Analysis at No. 4 (4.7 mm) Sieve and Coarser for Metal Bearing Ores and Related Materials[2]
ASTM E 828	Test Method for Designating the Size of REF-3 from its Sieve Analysis[2]

4.4.2 *German Standards*:

DIN 66 165 T1	Particle Size Analysis, Sieving Analysis, Fundamentals[4]
DIN 66 165 T2	Particle Size Analysis, Sieving Analysis, Procedure[4]
DIN/ISO 3310-1	Test Sieves Technical Requirements and Testing: Test Sieves of Metal Wire Cloth[4]
DIN/ISO 3310-2	Test Sieves of Perforated Metal Plate[4]
DIN/ISO 3310-3	Test Sieves of Electroformed Sheets[4]

4.4.3 *ISO Standards*:

ISO 2591-1	Test Sieving -Part 1—Methods Using Test Sieves of Woven Wire Cloth and Perforated Metal Plate[5]
ISO 4497	Metallic Powders—Determination of Particle Size by Dry Sieving[5]

4.4.4 *Japanese Standards*:

JIS Z8800	Test Sieves with Electroformed Sheet[7]
JIS Z8801	Test Sieves[7]
JIS Z8815	Test Sieving[7]

4.4.5 *Metal Powders Industry Standard*:

MPIF 05	Determination of Sieve Analysis of Metal Powders[8]

4.4.6 *French Standards*:

NF E 81-061	Sieves and Sieving—Punching and Stamping—Aperture and Pitch of Perforated Plates with Round Holes and Square Holes[6]
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[6]
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)[6]
NF ISO 14315	Industrial Wire Screens — Technical Requirements and Testing[6]
NF ISO 2194	Industrial Screens- Woven Wire Cloth, Perforated Plate and Electroformed Sheet-Designation and Nominal Sizes of Openings[6]
NF ISO 3310-2	Test Sieves—Technical Requirements and Testing—Part 2: Test Sieves of Perforated Metal Plate[6]
NF ISO 3310-3	Test Sieves—Technical Requirements and Testing — Part 3: Test Sieves of Electoformed Sheets[6]
NF ISO 4782	Metal Wire for Industrial Metal Screens and Woven Wire Cloth[6]
NF ISO 565	Test Sieves—Metal Wire Cloth, Perforated Metal Plate andElectroformed Sheet — Nominal Sizes of Openings[6]
NF ISO 9044	Industrial Woven Wire Cloth—Technical Requirements and Testing[6]
NF X 11-500	Sieves and Sieving—Terminology[6]
NF X 11-504	Metal Wire Cloth and Perforated Plate For Test Sieves—Technical Requirements and Verifications (E)[6]
NF X 11-508	Sieves and Sieving—Correspondence Table for Woven Metal Wire Cloth for Test Sieves (E)[6]
NF X 11-510	Sieves and Sieving—Wire Gauze with Square Apertures Made from Annealed Round Wire for Industrial Use—Wire Diameters[6]
NF X 11-511	Sieves and Sieving—Preformed Wire Gauze With Square Apertures Made from High Tensile Steel Round Wire for Industrial Sieving[6]
NF X 11-512	Sieves and Sieving—Vocabulary Relating to Defects in Woven Wire Cloths (E)[6]
NF X 11-515	Sieves and Sieving—Hollander Metal Weaves—Plain Weave Weft[6]

[8] Available from Metal Powders Industry Federation, 105 College Road East, Princeton, New Jersey 08540-56692.

NF X 11-516 Sieves and Sieving—Industrial Wire Screens—Tolerances[6]
NF X 11-519 Sieves and Sieving—Industrial Wire Screens—Number of Blemishes[6]
NF X 11-640 Test Method for Particle Size Analysis—Particle Size Analysis of Fine Powders with Air-Jet Sieving Device (E)[6]
NF X 11-642 Test Method for Particle Size Analysis—Sieving in Liquid Media of Powders of Particle Size Smaller than 200 Micrometers (E)[6]

SECTION 5—ELECTRICAL SENSING METHODS

4.5 *Related Standards*:

4.5.1 *ASTM Standards*:

ASTM C 690 Test Method for Particle Size Distribution of Alumina or Quartz by Electronic Counting[2]
ASTM D 4438 Test Method for Particle Size Distribution of Catalytic Material by Electronic Counting[2]
ASTM F 662 Test Method for Measurement of Particle Count and Size Distribution in Batch Samples for Filter Evaluation using an Electrical Resistance Particle Counter[2]

4.5.2 *British Standard*:

BS 3406: Part 5 Recommendation for Electrical Sensing Zone Method (the Coulter Principle)[3]

4.5.3 *French Standards*:

NF X 11-670 Test Method for Particle Size Analysis in an Electrolyte Suspension Using a Resistance Variation Counter[6]

4.5.4 *ISO Standard*:

ISO 13319 Particle Size Analysis Electrical Sensing Zone Method[5]

SECTION 6—LASER DIFFRACTION METHODS

4.6 *Related Standards*:

4.6.1 *ASTM Standards*:

ASTM B 822 Test Method for Particle Size Distribution of Metal Powders and Related Compounds by Light Scattering[2]
ASTM D 4464 Test Method for Particle Size Distribution of Catalytic Material by Laser Light Scattering[2]
ASTM E 1260 Test Method for Determining Liquid Drop Size Characteristics in a Spray Using Optical Non-Imaging Light-Scattering Instrument[2]
ASTM E 1458 Test Method for Calibration Verification of Laser Diffraction Particle Sizing Instruments Using Photomask Reticles[2]

4.6.2 *French Standard*:

NF X 11-666 Test Method for Particle Size Analysis—Determination of Particle Size of Powders—Optical Microscope Method (E)[6]

4.6.3 *ISO Standards*:

ISO 13320-1 Particle Size Analysis Laser Diffraction Methods Part 1: General Principles[5]
ISO/WD 13320-2 Particle Size Analysis Laser Diffraction Methods Part 2: Validation of Inversion Procedures[5]

SECTION 7—PHOTON CORRELATION SPECTROSCOPY METHODS

4.7 *Related Standards*:

4.7.1 *ISO Standards*:

ISO 13321 Test Method for Particle Size Analysis—Photon Correlation Spectroscopy[5]
ISO/WD 13321-2 Particle Size Analysis—Photon Correlation Spectroscopy Part 2: Validation of Inversion Procedures[5]

4.7.2 *French Standard*:

NF ISO 13321 Test Method for Particle Size Analysis—Photon Correlation Spectroscopy[6]

SECTION 8—IMAGE ANALYSIS METHODS

4.8 *Related Standards*:

4.8.1 *ASTM Standards*:

ASTM F 312 Test Method for Particle Shape Index by Microscopical Examination on Membrane Filters[2]
ASTM F 661 Practice for Particle Count and Size Distribution Measurement in Batch Samples for Filter Evaluation Using an Optical Particle Counter[2]
ASTM F 662 Test Method for Measurement of Particle Count and Size Distribution in Batch Samples for Filter Evaluation[2]

4.8.2 *British Standard*:

BS 3406: Part 4 Optical Microscope Method[3]

4.8.3 *ISO Standard*:

ISO/CD 13322–1 Particle Size Analysis—Static Image Analysis Methods[5]
ISO/CD 13322–2 Particle Size Analysis—Dynamic Image Analysis Methods[5]

4.8.4 *French Standards*:

NF X 11-660 Test Method for Grain Size Analysis Using Optical Microscopes—General Details of Microscope (E)[6]
NF X 11-661 Test Method for Particle Size Analysis—Determination of Particle Size of Powders—Optical Microscope (E)[6]
NF X 11-696 Test Method for Particle Size Analysis Through Image Analysis[6]

4.8.5 *German Standard*:

VDI 2269 Microscopic Investigation of Particles Survey[9]

SECTION 9—SINGLE PARTICLE LIGHT INTERACTION METHODS

4.9 *Related Standards*:

4.9.1 *ASTM Standards*:

ASTM F 25 Test Method for Sizing and Counting Airborne Particulate Contamination in Clean Rooms and Other Dust-Controlled Areas Designed for Electronic and Similar Applications (R 1979)[2]
ASTM F 658 Practice for Defining Size Calibration Resolution and Counting Accuracy of a Liquidborne Particle Counter Using Near-Monodisperse Spherical Particulate Material[2]
ASTM F 795 Practice for Determining the Performance of a Filter Medium Employing a Single Pass, Constant Rate, Liquid Test[2]

4.9.2 *British Standards*:

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

4.9.3 *ISO Standards*:

ISO 13323-1 Determination of Particle Size Distribution Single Particle Light Interaction Methods Part 1: Light Interaction Considerations[5]
ISO/DIS 13323-2 Determination of Particle Size Distribution Single Particle Light Interaction Methods Part 2: Light Scattering Method[5]
ISO/DIS 13323–3 Determination of Particle Size Distribution Single Particle Light Interaction Methods Part 3: Single Particle Light Extinction Device, Performance Specifications, and Operation Requirements[5]

SECTION 10—SMALL ANGLE X-RAY SCATTERING METHOD

4.10 *Related Standards*:

4.10.1 *ISO Standard*:

ISO/TS 13762 Particle Size Analysis—Small Angle X-Ray Scattering Methods[5]

SECTION 11—SAMPLING METHODS

4.11 *Related Standards*:

[9] Available from German Standards, Bismarkstra Be 33, 10625 Berlin.

4.11.1 *ANSI Standard*:

ANSI B74.6	Procedure for Sampling of Abrasive Grains, (R 1982)[10]

4.11.2 *ASTM Standards*:

ASTM B 215	Test Method for Sampling Finished Lots of Metal Powders[2]
ASTM B 821	Test Method for Liquid Dispersion of Metal Powders and Related Compounds for Particle Size Analysis[2]
ASTM B 859	Test Method for De-Agglomeration of Refractory Metal Powders and Their Compounds Prior to Particle Size Analysis[2]
ASTM C 322	Test Method for Sampling Ceramic Whiteware Clays[2]
ASTM D 75	Practice for Sampling Aggregates, DoD Adopted[2]
ASTM D 1045	Test Method for Sampling and Testing Plasticizers Used in Plastics[2]
ASTM D 2755	Test Method for Sampling and Reduction to Test Weight of Electrical Grade Magnesium Oxide[2]
ASTM D 3370	Practice for Sampling Water; NRC-DoD Adopted[2]
ASTM F 318	Practice for Sampling Airborne Particulate Contamination in Clean Rooms for Handling Aerospace Fluids (R 1983)[2]

4.11.3 *British Standard*:

BS 3406: Part 1	Guide to Powder Sampling[3]

4.11.4 *ISO Standards*:

ISO 3954	Test Method for Sampling Powders for Powder Metallurgical Purpose[5]
ISO/CD 14488	Particle Size Analysis Sample Preparation—Sample Splitting[5]
ISO 14887	Particle Size Analysis Sample Preparation—Dispersing Procedures for Powders in Liquids[5]

4.11.5 *Metal Powders Industry Standard*:

MPIF 01	Test Method for Sampling Finished Lots of Metal Powders[8]

4.11.6 *French Standards*:

NF X 11-693	Test Method for Particle Size Analysis—Liquid Suspending Media and Dispersing Agents (E)[6]
NF X 14-001	Test Method for Sampling Equipment—Conical Sampler[6]

SECTION 12—GENERAL METHODS AND INFORMATION

4.12 *Related Standards*:

4.12.1 *ASTM Standards*:

ASTM B 330	Test Method for Average Particle Size of Powders of Refractory Metals and Their Compounds by the Fisher Sub-Sieve Sizer[2]
ASTM C 604	Test Method for True Specific Gravity of Refractory Materials[2]
ASTM D 2638	Test Method for Real Density of Calcined Petroleum Coke by Helium Pycnometer[2]
ASTM D 3037	Test Method for Carbon Black—Surface Area by Nitrogen Adsorption[2]
ASTM D 4164	Test Method for Mechanically Tapped Apparent Packing Density of Formed Catalyst Particles[2]
ASTM D 4179	Test Method for Single Pellet Crush Strength of Formed Catalyst Shapes[2]
ASTM D 4781	Test Method for Mechanically Tapped Packing Density of Fine Catalyst Particles and Catalyst Carrier Particles[2]
ASTM D 5550	Test Method for Specific Gravity of Solid Soils by Gas Pycnometer[2]
ASTM D 6128	Test Method for Shear Testing of Bulk Solids Using the Jenike Shear Cell[2]
ASTM D 6393	Test Method for Bulk Solid characterization by Carr Indices[2]
ASTM D 6682	Test Method for Measuring the Shear Stresses of Powders Using the Peschi Rotational Split Level Shear Tester[2]
ASTM D 6683	Test Method for Measuring Bulk Density Values of Powders and Other Bulk Solids[2]
ASTM D 6773	Shear Test Method for Bulk Solids Using the SchulzeRing Shear Tester[2]
ASTM E 177	Practice for Use of the Terms Precision and Bias in ASTM Test Methods[2]
ASTM E 1620	Terminology Relating to Liquid Particles and Atomization[2]
ASTM E 691	Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method[2]
ASTM F 660	Practice for Comparing Particle Size in the Use of Alternative Types of Particle Counters[2]

4.12.2 *British Standard*:

BS 2955	Glossary of Terms Relating to Powders[3]

4.12.3 *German Standards*:

DIN 66 160	Analysis of Disperse Systems, Concepts[4]
DIN 66 161	Particle Size Analysis, Formula, Symbols, Units[4]

4.12.4 *ISO Standards*:

ISO 565	Test Sieves—Metal Wire Cloth, Perforated Metal Plate and Electroformed Sheet—Nominal Sizes of Openings[5]
ISO 2395 (E/F)	Test Sieves and Test Sieving—Vocabulary[5]
ISO 3310	Test Sieves—Technical Requirements and Testing[5]
ISO 3310-1	Part 1: Test Sieves of Metal Wire Cloth[5]
ISO 3310-2	Part 2: Test Sieves of Perforated Metal Plate[5]
ISO 3310-3	Part 3: Test Sieves of Electroformed Sheets[5]
ISO 9045 (E/F)	Industrial Screens and Screening—Vocabulary[5]
ISO/WD 15900	Particle Size Analysis Aerosol Electrical Mobility Analyzer[5]

4.12.5 *Metal Powders Industry Standard*:

MPIF 32	Test Method for Determination of Average Particle Size of Metal Powders Using the Fisher Subsieve Sizer[8]

4.12.6 *French Standards*:

NF X 11-630	Particle Size Analysis—Vocabulary (E)[6]
NF X 11-695	Particle Size Analysis—Designation of Sizing Methods[6]

4.12.7 *German Standard*:

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[9]

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

[10] Available from American National Standards Institute, 11 W. 42nd St., 13th Floor, New York, NY 10036.