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Standard Terminology Relating to Nonsieving Methods of Powder Characterization[1]

This standard is issued under the fixed designation E2589; 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.

INTRODUCTION

Particle size distribution, surface area, and other forms of particle analysis have been commonly adopted methods of verifying compliance with desired particle specifications for some time. Greater emphasis is now being placed on inter- and intralaboratory correlation of all particle measurement systems.

To ensure a better understanding of the comparison of testing results from particle measurement systems, terminology relating to the measurements must be clearly defined and documented so that both the recipient and generator of the data are in full agreement as to the meaning of the data. Every effort has been made here to ensure accuracy, precision, and clarity for the terms included in this terminology document. For Committee E29, this is an ongoing process with new terms being developed and defined for future inclusion. Suggestions and comments for additions, corrections, and revisions are welcomed.

1. Scope

1.1 This terminology covers the definitions of terms used in the description and procedures of analysis of particulate materials not ordinarily analyzed using test sieves. The terms relate directly to the equipment used in analysis, the physical forms of the materials to be analyzed, and selected descriptive data reduction and analysis formats.

1.2 Committee E29 on Particle and Spray Characterization believes that it is essential to include terms and definitions explicit to the committee's scope, regardless of whether the terms appear in existing ASTM standards. Terms that are in common usage and appear in common-language dictionaries are generally not included, unless they have specific meanings in the context of particle characterization different from the common-language definitions.

1.3 *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:*[2]

E2578 Practice for Calculation of Mean Sizes/Diameters and Standard Deviations of Particle Size Distributions

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[1] This terminology is under the jurisdiction of ASTM Committee E29 on Particle and Spray Characterization and is the direct responsibility of Subcommittee E29.02 on Non-Sieving Methods.

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

3. Significance and Use

3.1 Interpretation and use of data generated by particle characterization methods is highly dependent on the definitions of terms describing that data. It is extremely important that those terms be defined in precisely the same way both when comparing data from different characterization techniques and even when correlating data from the same technique.

3.2 It is likewise important that users of particle characterization methods and the data generated therefrom understand the principles of the methods, so that differences and similarities in the data can be interpreted in relation to those principles. That understanding can help to avoid disagreements when data from different characterization methods are compared.

3.3 The definitions contained in this terminology will aid in the interpretation of particle characterization data with respect to the method(s) used to produce that data.

4. Terminology

area, *A*, *n—in image analysis*, sum of pixels representing a binary object.

aspect ratio, *n—in image analysis*, ratio of the maximum to the minimum dimensions as determined by the technique.

binarization, *n—in image analysis*, process of reducing a digital image to a binary image.

binary object, *n—in image analysis*, set of connected binary pixels representing the two dimensional projection of a particle.

binary image, *n—in image analysis*, image formed by an array of pixels having only two possible values, representing objects and background, as a result of binarization. Synonymous with *binary plane* and *bitplane*.

blind pore, *n*—open pore having only a single connection with an external surface.

circularity, *C*, *n—in image analysis*, a measure of the similarity of a particle's image to the shape of a circle and defined as $C = \sqrt{(4\pi A/P^2)}$, where A is the area of the particle's image and P is the perimeter of the particle's image.

convex perimeter, P_C, *n—in image analysis*, total length of line segments connecting the Feret tangent points around a binary object.

DISCUSSION—
This is the perimeter that would be obtained if a rubber band was stretched around the object.

cumulative distribution, *n*—the representation of the total fraction of the population, expressed as either mass-, volume-, area-, or number-based, that is greater than or less than discrete size values.

dispersion, *n*—system consisting of particles distributed in a solid, liquid, or gas.

dynamic image analysis, *n*—particle size and shape analysis using computer image analysis techniques on instantaneously-captured still-frame projected images of particles in motion.

DISCUSSION—
Some instruments use a moving measurement apparatus on static particles.

electrical sensing zone analysis, *n*—particle size analysis in which particles suspended in a conductive liquid medium pass through a narrow orifice in an insulating material separating two electrodes. Each traversing particle generates an electrical signal proportional to its volume.

electrical sensing zone equivalent spherical diameter, *n*—diameter of a hypothetical spherical particle that when suspended in a conducting fluid would yield the same electrical signal as the particle under analysis.

emulsion, *n*—a system that consists of one liquid dispersed in another.

equivalent aerodynamic diameter, *n*—the diameter of a unit density sphere that has the same inertial properties as the particle under analysis, under the same conditions

equivalent area diameter, *D*,*n*—*in image analysis*, diameter of a circle having the same area as the binary object. Synonymous with *circular diameter, equivalent diameter*, and *equivalent circular diameter*.

equivalent spherical diameter, *n*—diameter of a sphere that has the same geometrical characteristics (projected area, volume, etc.) or the same behavior (settling, light scattering, etc.) as the particle under analysis.

equivalent Stokes diameter, *n*—the diameter of a sphere of the same density as the particle under analysis, undergoing the same limiting velocity when moving in the same medium under laminar flow conditions.

equivalent surface area diameter, *n*—the diameter of a sphere that has the same surface area as the particle under analysis.

equivalent volume diameter, *n*—diameter of a sphere that has the same volume as the particle under analysis.

Feret diameter, *F*,*n*—distance between two parallel tangents on opposite side of a binary object. Synonymous with *Feret dimension*.

frequency distribution, *n*—the representation of the relative fractions of a particle size distribution represented by (or associated with) discrete size values (recognizing that an individual value may represent a range of values).

maximum Feret diameter, F_{max},*n*—longest Feret dimension found for a binary object. Synonymous with *maximum Feret dimension*.

DISCUSSION—
Refer to Fig. 1 for clarity.

mean particle size, *n*—a measure of the central tendency of a particle size distribution, according to the Moment-Ratio (M-R) definition system of Practice E2578.

DISCUSSION—
The mean particle size may be related to the number, surface area, volume, or other particle characteristic, depending on which moments of the distribution are used in its calculation. (See, for example, Table 1 in Practice E2578.)

median particle size, *n*—the particle size at which half the distribution (by mass, volume, number, etc.) is larger than and half smaller than the stated size.

minimum Feret diameter, F_{min},*n*—shortest Feret dimension found for a binary object. Synonymous with *minimum Feret dimension*.

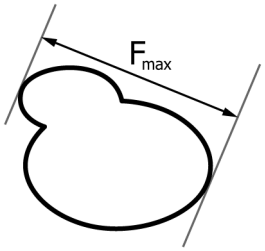

FIG. 1 Maximum Feret Diameter, F_{max}