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Standard Practice for Reporting Particle Size Characterization Data¹

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INTRODUCTION

Correlation and comparison of particle size measurement data are of general importance to researchers, processors, suppliers, vendors, and users of particulate materials. Since there are numerous methods and devices in use, comparisons of size measurement data are subject to perceived inconsistencies that may be much reduced by the use of standardized reporting.

Data generated by any one size measurement method may be consistent in many respects, yet be troublesome to correlate due to variances in data processing and reporting formats among equipment manufacturers. Data generated from methods employing different physical principles present serious correlation problems due to their sensing of different parameters related to particle size and some unrelated, such as density, shape and optical properties. Standardized reporting may reduce confusion resulting from different particle size measurement practices.

1. Scope

1.1 This practice covers reporting particle size measurement data.

1.2 This practice applies to particle size measurement methods, devices, detail levels, and data formats for dry powders, and wet suspensions of solids, gels, or emulsion droplets. This practice does not pertain to liquid particles.

NOTE 1—For information on reporting liquid particle measurement data, refer to Practice E799.

1.3 This practice does not concern particle concentration information.

1.4 This practice uses SI (Système International) units as standard. State all numerical values in terms of SI units unless specific instrumentation software reports particle size information, including percentiles, indices, and distributions as tabulations and graphs using alternate units. In this case, present both reported and equivalent SI units in the final written report. Refer to Practice E380 for proper usage of SI units.

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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.

1.6 *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
 - E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods
 - E380 Practice for Use of the International System of Units (SI) (the Modernized Metric System) (Withdrawn 1997)³
 - E456 Terminology Relating to Quality and Statistics
 - E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method
 - E799 Practice for Determining Data Criteria and Processing for Liquid Drop Size Analysis

3. Significance and Use

3.1 When evaluating the particle size information, if the procedures of the data processing are not available, the user of the data must make assumptions concerning the reported data

¹ This practice 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 The last approved version of this historical standard is referenced on www.astm.org.

in the event of analytical inconsistencies. In order for different data sets to be compared it is crucial that the parties report the analytical techniques and methods or procedures for evaluating, calculating, compiling or otherwise processing the data to be reported.

3.2 Particle size characterization information can be reported in three levels of detail in order to satisfy user's needs.

3.2.1 Level 1 applies when only basic information about the material is required, and shall be provided with each shipment. This level represents the minimum information that shall be reported. Level 1 information may be sufficient in such cases as identifying a certain grade of a material or when detailed knowledge of analytical methodology is not needed.

3.2.2 Level 2 presumes the need for knowledge of methodology on the user's part and allows the user to make a more informed judgment about the information provided in Level 1.

3.2.3 Level 3 provides detailed written procedures to allow duplication of the measurement.

3.2.4 Information provided through Levels 2 and 3 will allow users to perform comparative material evaluations among several suppliers, set specifications or define a purchase agreement, perform inter-laboratory studies and most importantly resolve disputes among suppliers and users.

3.3 Reported particle size measurement is a function of both the actual particle dimension and 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 the reported particle size results.

4. Procedure

4.1 The particle size characterization report shall include Level 1 information with Level 2 or 3, or both, being supplied upon agreement between supplier and user. Level 2 reports shall include all information provided in Level 1. Level 3 reports shall include all information provided in Levels 1 and 2.

4.2 The supplier of a product lot shall provide the user with at least Level 1 information in a mutually agreed upon time frame relative to delivery of the product. Structure the report using 5.2 through 5.2.8 as guidelines.

4.3 Levels 2 and 3 shall be made available to the user at mutually agreeable costs and terms of disclosure. Structure the reports using 5.3 through 5.3.14.3 and 5.4 through 5.4.18, respectively, as guidelines.

4.4 Particle Size Characterization Data Sheet—Level 1:

4.4.1 The Level 1 report shall contain the designation of this ASTM standard practice (E1617).

4.4.2 The report shall contain sample identification information such as material type, sample source or submitter, and sample lot number.

4.4.3 The report shall include a minimum reporting of size parameter(s). Minimum reporting will be defined by agreement

between supplier and user of the data, such as a calculated mean diameter, median diameter, or both.

4.4.4 The report shall include the principle of measurement, such as sieving, sedimentation, light blockage, electronic zone sensing, laser light scattering, and so forth. Often, the measurement principle can be defined by describing the instrumentation or apparatus used for the analysis. All references to "diameter" shall include appropriate adjectives to indicate the sensing basis.

4.4.5 The report shall include the bases for the reported parameters. Examples of parameter basis are frequently distribution, scattering area distribution, and mass distribution.

4.4.6 The report shall include the range of size measurement, in appropriate SI units.

4.5 Particle Size Characterization Data Sheet—Level 2:

4.5.1 The Level 2 report shall include all information listed under 4.4.

4.5.2 The report shall include the manufacturer's identification of the instrument or apparatus used to perform the particle size measurement.

4.5.3 The report shall include all of the parameters required to use the instrument or apparatus.

4.5.4 The report shall include the software version number(s) of any computerized instrument used to measure particle size.

4.5.5 The report shall include a description of the basis of calculations performed by the instrument, to the extent available from the instrument manufacturer. Also, the report shall include description of any additional calculations performed outside of the instrument software package.

4.5.6 The report shall include basic statistical information, such as standard deviation, number of degrees of freedom, and confidence interval, and shall include a description of the calculations used to produce this statistical information.

4.5.7 The report shall include the specifications or limits of the measurement as defined by the instrument manufacturer.

4.5.8 The report shall include a complete description of sample preparation.

4.6 Particle Size Characterization Data Sheet—Level 3:

4.6.1 The Level 3 report shall include all information listed under 4.4 and 4.5.

4.6.2 The report shall include operating procedures associated with the particle size measurement and the complete designation of any published procedures, such as ASTM or industry standard test methods.

4.6.3 The report shall include a complete description of any instrument operational and calibration procedures not specified by a published procedure.

4.6.4 The report shall include a statement of precision and bias of the particle size measurement data where available.

5. Report Guidelines

5.1 Typical reports based upon the information categories presented in items 4.4 through 4.6.4 are shown below. The actual text of the report will depend upon the particular particle size measurement technique used. Users and suppliers should agree in advance on the particular size parameters reported.

5.2 Particle Size Characterization Data Sheet—Level 1:

- 5.2.1 This ASTM designation,
- 5.2.2 Material,
- 5.2.3 Source,
- 5.2.4 Lot number, and
- 5.2.5 *Size Parameter(s). For Example:*
 - 5.2.5.1 Geometric mean diameter,
 - 5.2.5.2 Modal diameter,
 - 5.2.5.3 Median diameter, and
 - 5.2.5.4 Other defined size related parameter.
- 5.2.6 Data basis (frequency, mass, etc.),
- 5.2.7 Measurement range, and
- 5.2.8 Measurement principle.

5.3 Particle Size Characterization Data Sheet—Level 2:

- 5.3.1 This ASTM designation,
- 5.3.2 Material,
- 5.3.3 Source,
- 5.3.4 Lot number, and
- 5.3.5 *Size Parameter(s). For Example:*
 - 5.3.5.1 Geometric mean diameter,
 - 5.3.5.2 Modal diameter,
 - 5.3.5.3 Median diameter, and
 - 5.3.5.4 Other defined size related parameter.
- 5.3.6 Data basis (frequency, mass, etc.),
- 5.3.7 Measurement range,
- 5.3.8 Measurement principle,
- 5.3.9 Instrument and model,
- 5.3.10 *Measurement Conditions*—Instrument operational parameters,
- 5.3.11 Software version number(s),
- 5.3.12 Calculation method,
- 5.3.13 *Basic Statistics (Refer to Terminology E456):*
 - 5.3.13.1 Standard deviation,
 - 5.3.13.2 Degrees of freedom, and
 - 5.3.13.3 Confidence level.
- 5.3.14 *Sample Preparation:*
 - 5.3.14.1 Dispersion medium,
 - 5.3.14.2 Dispersion steps (equipment, power rating, duration), and
 - 5.3.14.3 Dispersion verification.

5.4 Particle Size Characterization Data Sheet—Level 3:

- 5.4.1 This ASTM designation,
- 5.4.2 Material,
- 5.4.3 Source,
- 5.4.4 Lot number,
- 5.4.5 *Size Parameter(s). For Example:*
 - 5.4.5.1 Geometric mean diameter,
 - 5.4.5.2 Modal diameter,
 - 5.4.5.3 Median diameter, and
 - 5.4.5.4 Other defined size related parameter.
- 5.4.6 Data basis (frequency, mass, etc.),
- 5.4.7 Measurement range,
- 5.4.8 Measurement principle,
- 5.4.9 Instrument and model,
- 5.4.10 *Measurement Conditions*—Instrument operational parameters,
- 5.4.11 Software version,
- 5.4.12 Calculation method,
- 5.4.13 *Basic Statistics (Refer to Terminology E456):*
 - 5.4.13.1 Standard deviation,
 - 5.4.13.2 Degrees of freedom, and
 - 5.4.13.3 Confidence level.
- 5.4.14 *Sample Preparation:*
 - 5.4.14.1 Dispersion medium,
 - 5.4.14.2 Dispersion steps (equipment, power rating, duration), and
 - 5.4.14.3 Dispersion verification.
- 5.4.15 Analytical procedure and number,
- 5.4.16 Precision and bias (refer to Practices E177 and E691),
- 5.4.17 Test or assay number, and
- 5.4.18 Calibration or standardization procedure.

5.5 Example Report Form—An example of a report form (data sheet) incorporating all the required parameters may be found in **Appendix X1**.

6. Keywords

6.1 particle characterization; particle size; particle size analysis; particle size characterization; particle size distribution; particle size report