Designation: F3560 – 22

Standard Specification for Additive Manufacturing – Data – Common Exchange Format for Particle Size Analysis by Light Scattering[1]

This standard is issued under the fixed designation F3560; 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 specification has been developed to facilitate exchanging and analyzing particle size distribution (PSD) by light scattering data from databases, data management systems, point of origin, or other data sources that may use different data dictionaries, schemas, or formats.

1.2 This specification prescribes the use of a common exchange format in such a way that PSD data defined through proprietary means can be easily exchanged for process understanding and qualification.

1.3 This specification facilitates the interoperability of PSD data by identifying the data elements defined in standardized terminology, as well as defining those salient terms with indisputable meanings. In doing so, this specification extends the common AM data dictionary defined in Practice F3490 to encapsulate PSD process-specific data elements. Generic data elements and relationships present in that standard are inherited and applied in this practice where relevant.

1.4 This specification specifies names that serve to uniquely identify the PSD data elements. The data type, value domain, and term definition for each data element are also specified in this practice. References are provided for those data elements with established definitions or reporting guidelines in existing standards.

1.5 This specification prescribes a file format and structure for the exchange of PSD data. This format defines a method for sharing data via the defined PSD data elements herein and provides a basis for validation of data exchanged using this format.

1.6 This specification recommends levels of data sharing that vary from minimal to robust. It prescribes best practices for checking conformance based on the common data exchange format.

1.7 This specification does not specify:

1.7.1 An exhaustive set of data items that could be exchanged related to PSD by light scattering.

1.7.2 A definition of a minimum viable data set for PSD by light scattering.

1.7.3 Data items or an exchange format for PSD methods other than light scattering, for example, imaging or sieving.

1.7.4 Data elements for data modules related to PSD (for example, for personnel, material, or equipment).

1.7.5 The implementation details of how data should be imported to proprietary data management systems from the common data exchange format.

1.7.6 The implementation details of how data should be exported from proprietary data management systems to the common data exchange format.

1.7.7 Guidelines for creating unique identifiers for data module records

1.8 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.9 *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]

B821 Guide for Liquid Dispersion of Metal Powders and Related Compounds for Particle Size Analysis

B822 Test Method for Particle Size Distribution of Metal Powders and Related Compounds by Light Scattering

E1617 Practice for Reporting Particle Size Characterization Data

E3340 Guide for Development of Laser Diffraction Particle Size Analysis Methods for Powder Materials

[1] This specification is under the jurisdiction of ASTM Committee F42 on Additive Manufacturing Technologies and is the direct responsibility of Subcommittee F42.08 on Data.

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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.

F3490 Practice for Additive Manufacturing — General Principles — Overview of Data Pedigree

2.2 *ISO Standards:*[3]

ISO 8601 Date and time format

ISO 13320 Particle size analysis — Laser diffraction methods

3. Terminology

3.1 *Abbreviations:*

3.1.1 *AM*—Additive Manufacturing

3.1.2 *CDD*—Common Data Dictionary

3.1.3 *CDEF*—Common Data Exchange Format

3.1.4 *ID*—Identifier

3.1.5 *JSON*—Java Script Object Notation

3.1.6 *PSD*—Particle Size Distribution

3.1.7 *SI*—International System of Units

3.1.8 *TIC*—Test / Inspection / Characterization

3.2 *Definitions:*

3.2.1 For the purposes of this document, the terms and definitions given in Practice F3490 shall apply.

4. PSD by Light Scattering CDEF Requirements

4.1 Data shared according to this standard shall conform to the data element definitions in Section 6. Any additional data elements included in the data package and not defined in this standard shall have definitions agreed upon by the parties involved in the data exchange.

4.2 If the JSON format is used, data shared according to this standard shall conform to the JSON schema defined in Annex A1 up to the definition of required terms, which should be established by the parties involved in the exchange of data. Those parties may refer to the recommended reporting levels in Section 6 to establish required data elements. Note that the schema in Annex A1 sets required data elements per Recommended Reporting Level 1 with a dry dispersion method, the "required" tags in the schema should be updated to reflect the agreed-upon data reporting level. See the JSON schema documentation for more information about specifying required elements: https://json-schema.org/understanding-json-schema/reference/object.html#required-properties.[4] Parties involved in the exchange of data may agree upon a different format (for example, XML-based) while utilizing the structure developed in Annex A1.

NOTE 1—Descriptive information for the JSON schema defined in Annex A1 is provided in Appendix X1.

4.3 Data elements not included in this specification may be added to the format when agreed upon by the parties exchanging data. Data elements added thusly should have names prepended with an underscore ("_") when included in the JSON CDEF or corresponding JSON schema as defined in Annex A1.

[3] Available from International Organization for Standardization (ISO), ISO Central Secretariat, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, https://www.iso.org.

[4] See Referenced Link after Table 3 for an active link to this web page.

5. Reporting Levels

5.1 Data reporting levels are suggested and based on reporting guidelines in Practice E1617 and ISO 13320. Recommended reporting levels are suggested for each data element in Table 1, Table 2, and Table 3. Two parties exchanging data may agree to follow different, mutually agreed-upon reporting requirements. Non-required data elements may be omitted when exchanging data in these cases.

5.2 A data package satisfying Recommended Reporting Level 1 shall include basic identifiers and descriptors of the test. It includes minimal test preparation details and sample information as well as the most essential results to analyze the data. Two parties exchanging data may agree to follow different, mutually agreed-upon reporting requirements. Non-required data elements may be omitted when exchanging data in these cases.

5.3 A data package satisfying Recommended Reporting Level 2 includes additional information on ambient environment conditions and test preparation details. Test results are added that can be derived from the results included in Level 1.

5.4 A data package satisfying Recommended Reporting Level 3 includes full equipment calibration information and test performance details. Additionally, linkages to complete information module records as defined in Practice F3490 are maintained. For example, the TIC Operator data element has Recommended Reporting Level 1 for the operator's name as a minimum requirement. At Level 3, the operator's unique identifying ID or, equivalently, their complete record of Personnel Information Module data elements as defined in Table 24 of Practice F3490, shall be reported.

5.5 Data elements with a Reporting Level marked as O in Table 1, Table 2, and Table 3 are considered optional at all levels.

5.6 Procedures using a wet dispersion method shall include data elements marked with a W in the Reporting Level column in Table 1. Those using a dry dispersion method shall include data elements marked with a D.

6. PSD by Light Scattering Data Element Definitions

6.1 *Data Type and Common Value Set Definition:*

6.1.1 Data types (for example, string, integer) used by the data element definitions in this standard are as defined in Practice F3490 Table 1.

6.2 *Data Element Definitions:*

6.2.1 The data elements for PSD by light scattering are listed and described in this section.

6.2.2 Some data elements are inherited from the Test / Inspection / Characterization information module defined in Practice F3490, most notably, those beginning with TIC. PSD is a specific type of Test / Inspection / Characterization and these terms are maintained as-is for consistency.

6.2.3 A dataset shall specify the version of this specification it is conforming to in order to reduce miscommunications.

NOTE 2—As this standard continues to evolve, the data elements, relationships, or file format will be updated. It is possible that this will