



Designation: F3490 – 21

Standard Practice for Additive Manufacturing — General Principles — Overview of Data Pedigree¹

This standard is issued under the fixed designation F3490; 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 The scope of this document outlines the interpretation of additive manufacturing (AM) data. Currently, legacy AM data is stored in different databases or data management systems, each of which uses its own data dictionary. A common data dictionary allows AM data pedigree to be discovered, mapped, federated, and analyzed to improve both the understanding and qualification of AM processes and parts.

1.2 A common data dictionary facilitates the interoperability, searchability, and reusability of AM data by (1) identifying the general AM data pedigree elements already defined in a standardized terminology and (2) defining those salient terms with indisputable semantics (meanings). The goal of this document is to provide a first subset of the common data dictionary by which AM data may be collected, curated, and shared, regardless of which technology platform and software are used for data storage and exchange.

1.3 The common data dictionary also specifies a way to group AM data pedigree into fifteen information modules pertaining to different aspects of the entire additive manufacturing process.

1.4 The common data dictionary approach specifies data element names that serve to uniquely identify the AM 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 in existing standards.

1.5 The data elements identified in this common data dictionary are considered essential, because they are most frequently encountered in AM, process agnostic and technology independent. They are broadly applicable to all the process categories defined in ISO/ASTM 52900. It is intended to be a starting point, not all-encompassing.

1.6 The common data dictionary does not specify:

1.6.1 A complete set of data items to be exchanged through AM development lifecycle and value chains.

1.6.2 A minimum set of data items to be exchanged for AM lifecycle and value chain activities.

1.6.3 A common AM data exchange format.

1.6.4 The details associated with how the common descriptions of data items should be implemented for the development of new data systems or data federations among heterogeneous data systems.

1.7 Additional data elements beyond those defined in existing ASTM, ISO, AWS, NASA and SAE standards have been introduced to provide increased utility for AM. These new data items are generally common-sense and frequently used in the AM industry.

1.8 *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.*

1.9 *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

A1080 Practice for Hot Isostatic Pressing of Steel, Stainless Steel, and Related Alloy Castings

E1338 Guide for Identification of Metals and Alloys in Computerized Material Property Databases

E2077 Specification for Analytical Data Interchange Protocol for Mass Spectrometric Data

E2339 Practice for Digital Imaging and Communication in Nondestructive Evaluation (DICONDE)

¹ This practice 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.

2.2 ISO/ASTM Standards:²

- 52900 Terminology for Additive Manufacturing Technologies
- 52915 Specification for additive manufacturing file format (AMF) Version 1.2
- 52921 Terminology for Additive Manufacturing—Coordinate Systems and Test Methodologies
- 52930 Additive manufacturing qualification principles — Installation, operation and performance (IQ, OQ, PQ) of PBF-LB equipment

2.3 ISO Standards:³

- ISO 5127 Information and documentation — Foundation and vocabulary
 - ISO/IEC 6523-1 Information technology — Structure for the identification of organizations and organization parts — Part 1: Identification of organization identification schemes
 - ISO 8601-1 Date and time — Representations for information interchange — Part 1: Basic rules
 - ISO 11145 Optics and photonics — Lasers and laser-related equipment — Vocabulary and symbols
 - ISO 11161 Lasers and laser-related equipment — Test methods for laser beam widths, divergence angles and beam propagation
 - ISO/IEC 11179-1 Information technology — Metadata registries (MDR) — Part 1: Framework
 - ISO/IEC 11179-3 Information technology — Metadata registries (MDR) — Part 3: Registry metamodel and basic attributes — Amendment 1
 - ISO 11238 Health informatics — Identification of medicinal products — Data elements and structures for the unique identification and exchange of regulated information on substances
 - ISO/IEC 11404 Information technology — General-Purpose Datatypes (GPD)
 - ISO/IEC 11578 Information technology — Open Systems Interconnection — Remote Procedure Call (RPC)
 - ISO 16781 Space systems — Simulation requirements for control system
 - ISO 19160 Addressing — Part 4: International postal address components and template language
 - ISO 19165-1 Geographic information — Preservation of digital data and metadata — Part 1: Fundamentals
 - ISO 22745-2 Industrial automation systems and integration — Open technical dictionaries and their application to master data — Part 2: Vocabulary
 - ISO/IEC 29155 Systems and software engineering – Information technology project performance benchmarking framework
- ## 2.4 SAE Standards:⁴
- SAE AMS 2750 Pyrometric Requirements for Heat Treatments
 - SAE AMS 7001 Nickel Alloy, Corrosion and Heat-Resistant,

Powder for Additive Manufacturing, 62Ni – 21.5Cr – 9.0Mo – 3.65Nb

SAE ARP1917 Rev. A Aerospace Recommended Practice, Clarification of Terms Used in Aerospace Metals Specifications

2.5 NASA Standards:⁵

MSFC-STD-3716 Standard for Additively Manufactured Spaceflight Hardware by Laser Powder Bed Fusion in Metal

MSFC-SPEC-3717 Specification for Control and Qualification of Laser Powder Bed Fusion Metallurgical Processes

2.6 ASME Standard:⁶

ASME Y14.46 – 2017 Product Definition for Additive Manufacturing

2.7 AWS Standard:⁷

AWS D20.1/D20.1M Specification for Fabrication of Metal Components using Additive Manufacturing

3. Terminology

3.1 Acronyms:

- 3.1.1 CAD—computer aided design
- 3.1.2 DB—database
- 3.1.3 DOD—Department of Defense
- 3.1.4 ID—identifier
- 3.1.5 ITAR—International Traffic in Arms Regulations
- 3.1.6 PLM—product lifecycle management
- 3.1.7 TIC—test / inspection / characterization
- 3.1.8 URI—uniform resource identifier
- 3.1.9 UUID—universally unique identifier

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *controlled vocabulary*, *n*—finite set of values that represent the only allowed values for a data item. **ISO**

11238:2018

3.2.2 *data dictionary*, *n*—formal repository of terms used to describe data. **ISO 19165-1: 2018**

3.2.3 *data element*, *n*—a unit of information as defined by a single entry in the *data dictionary*. **E2339**

3.2.4 *data element name*, *n*—a unique name for each data element.

3.2.5 *data type*, *n*—the kind of data to be included in the data element, such as numbers, character string, and date. **E1338**

3.2.6 *definition*, *n*—the meaning of a data element defined in a standard or common sense.

3.2.7 *enumerated value domain*, *n*—value domain that is specified by a list of all its permissible values. **ISO/IEC**

11179-3:2013

⁵ Available from the NASA Technical Standards System at the NASA website www.standards.nasa.gov.

⁶ Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Two Park Ave., New York, NY 10016-5990, <http://www.asme.org>.

⁷ Available from American Welding Society (AWS), 8669 NW 36 St., #130, Miami, FL 33166-6672, <http://www.aws.org>.

³ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

⁴ Available from SAE International (SAE), 400 Commonwealth Dr., Warrendale, PA 15096, <http://www.sae.org>.