



Designation: E3206 – 19

Standard Guide for Reporting the Physical and Chemical Characteristics of a Collection of Nano-Objects¹

This standard is issued under the fixed designation E3206; 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 provides guidelines for a description system to report the physical and chemical characteristics of collections of nano-objects. It establishes information categories and descriptors useful in describing collections of nano-objects uniquely and such that the equivalency of two or more collections of nano-objects can be determined according to specific criteria.

1.2 This guide is designed to be directly applicable to reporting the physical and chemical characteristics of collections of nano-objects in most circumstances, including, but not limited to, reporting original research results in the archival literature, developing ontologies, database schemas, data repositories, and data reporting formats, specifying regulations, and enabling commercial activity.

1.3 This guide is applicable to collections of naturally occurring, engineered, and manufactured nano-objects.

1.4 One goal of the guide is to help ensure that when measurement results are reported, they are reported uniformly.

1.5 A second goal of the guide is to encourage reports on the properties and functionalities of a collection of nano-objects to include as much detail as possible about the physical and chemical characteristics of that collection so it is uniquely specified.

1.6 This guide does not cover the chemical reactions or reactivity of a collection of nano-objects.

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

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

D16 Terminology for Paint, Related Coatings, Materials, and Applications

E2456 Terminology Relating to Nanotechnology

E3172 Guide for Reporting Production Information and Data for Nano-Objects

E3144 Guide for Reporting the Physical and Chemical Characteristics of Nano-Objects

2.2 ISO Standards:³

ISO 26824:2013(en) Particle Characterization of Particulate Systems – Vocabulary

ISO/TS 12805:2011(en) Nanotechnologies – Materials Specifications – Guidance on Specifying Nano-Objects

ISO/TS 80004-1:2015(en) Nanotechnologies – Vocabulary – Part 1: Core Terms

2.3 Other Documents:

The Uniform Description System for Materials on the Nanoscale CODATA-VAMAS Working Group on the Description of Nanomaterials, as released on 25 May 2016⁴

¹ This guide is under the jurisdiction of ASTM Committee E56 on Nanotechnology and is the direct responsibility of Subcommittee E56.01 on Informatics and Terminology.

Current edition approved Nov. 15, 2019. Published December 2019. DOI: 10.1520/E3206-19.

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 Available from International Organization for Standardization (ISO), ISO Central Secretariat, BIBC II, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, <http://www.iso.org>.

⁴ Available from Committee on Data (CODATA) International Science Council, 5 rue Auguste Vacquerie, 75016 Paris, France, <https://www.codata.org/nanomaterials>.

3. Terminology

3.1 *Definitions*—For definitions of general terms used in this standard, see *ASTM Online Terminology Dictionary of Engineering Science and Technology*.⁵

3.2 Data Description Definitions:

3.2.1 *descriptor, n*—numerical data or text that expresses the measurement, observation, or calculational result of some aspect of an object..

3.2.1.1 *Discussion*—A descriptor conveys both the semantics of the results as well as the result itself.

3.2.2 *information category, n*—a set or group of related descriptors that represent a property, characteristic, interaction, performance, or other feature of an object.

3.2.2.1 *Discussion*—Information categories may be hierarchical and contain subcategories (referred to as such), each containing a set of descriptors.

3.2.2.2 *Discussion*—Information categories and their subcategories are constructed to convey understanding of the structure, properties, features, and performance of an object.

3.2.2.3 *Discussion*—A descriptor can occur in more than one information category.

3.2.2.4 *Discussion*—It is the responsibility of the owner of data or information resources using an information category to ensure that data and information redundancy is adequately addressed.

3.3 Nanomaterials Terminology:

3.3.1 *agglomerate, n*—collection of weakly or medium-strongly bounded nano-objects where the resulting external surface area is similar to the sum of the surface areas of the individual components.

3.3.1.1 *Discussion*—The forces holding an agglomerate together are weak forces, for example, van der Waals forces, or simple physical entanglement.

3.3.1.2 *Discussion*—Agglomerates are also termed secondary nano-objects and the original sources of nano-objects are termed primary nano-objects.

3.3.1.3 *Discussion*—Adapted from ISO 26824:2013(en), 1.2, with the substitution of “nano-objects” for “particles” in the definition and the *Discussions*.

3.3.2 *aggregate, n*—comprising strongly bonded or fused nano-objects where the resulting external surface area is significantly smaller than the sum of surface areas of the individual components.

3.3.2.1 *Discussion*—The forces holding an aggregate together are strong forces, for example, covalent or ionic bonds, or those resulting from sintering or complex physical entanglement, or otherwise combined former primary nano-objects.

3.3.2.2 *Discussion*—Aggregates are also termed secondary nano-objects and the original sources of nano-objects are termed primary nano-objects.

3.3.2.3 *Discussion*—Adapted from ISO 26824:2013(en), 1.2, with the substitution of “nano-objects” for “particles” in the definition and the *Discussions*.

3.3.3 *collection of nano-objects, n*—two or more nano-objects that are associated in some way..

3.3.3.1 *Discussion*—The nano-objects in a collection can be physically associated, such as in an aggregate or agglomerate, or a simple grouping, such as a commercial batch of nano-objects, or some combination thereof.

3.3.3.2 *Discussion*—A collection of nano-objects and individual nano-objects are the two major types of nanomaterials.

3.3.4 *engineered nanomaterial, n*—nanomaterial designed for specific purpose or function.

ISO/TS 80004-1:2015(en), 2.8

3.3.5 *equivalency, n*—the ability of a description system to establish that two objects as assessed by different disciplines or user communities are the same according to specified criteria.

3.3.5.1 *Discussion*—In this guide, equivalency is the ability to establish that two nano-objects are the same according to specified criteria.

3.3.6 *manufactured nanomaterial, n*—nanomaterial intentionally produced to have selected properties or composition.

ISO/TS 80004-1:2015(en), 2.9

3.3.7 *nanomaterial, n*—material with any external dimension in the nanoscale or having internal structure or surface structure in the nanoscale. **ISO/TS 80004-1:2015(en), 2.4**

3.3.8 *nano-object, n*—discrete piece of material with one, two or three external dimensions in the nanoscale.

ISO/TS 80004-1:2015(en), 2.10

3.3.8.1 *Discussion*—The second and third external dimensions are orthogonal to the first dimension and to each other.

ISO/TS 80004-1:2015(en), 2.5

3.3.8.2 *Discussion*—A nano-object is the smallest unit of nanomaterial that exists as a separate functional entity.

3.3.8.3 *Discussion*—A multilayer structure that is the smallest unit of nanomaterial with a specific functionality is defined herein to be a nano-object (see 3.3.7).

3.3.9 *nano-object feature, n*—a distinctive aspect of a nano-object..

3.3.9.1 *Discussion*—A nano-object feature can occur anywhere within or upon the nano-object.

3.3.9.2 *Discussion*—Within this guide, the term *nano-object feature* is sometimes referred to simply as a *feature*.

3.3.10 *naturally-occurring nanomaterial, n*—a nanomaterial made exclusively by natural processes..

3.3.10.1 *Discussion*—A naturally occurring nanomaterial, when altered in any way by a process planned or controlled by humans, is, by definition, an engineered or manufactured nanomaterial.

3.3.10.2 *Discussion*—A nanomaterial produced by a natural process not planned or controlled by humans, for example, digestion or weathering of a rock, is naturally occurring.

3.3.10.3 *Discussion*—There are instances when it is ambiguous or difficult to say whether a nanomaterial is naturally occurring, engineered, or manufactured.

3.3.11 *uniquely, adv*—the quality of having uniqueness..

3.3.12 *uniqueness, n*—the ability of a description system to differentiate one collection of nano-objects from every other collection of nano-objects and to establish which specific

⁵ ASTM Online Terminology Dictionary of Engineering Science and Technology, available from ASTM International, ASTM Stock Number: DEFONLINE.