Designation: E 2544 – 07

Standard Terminology for Three-Dimensional (3-D) Imaging Systems[1]

This standard is issued under the fixed designation E 2544; 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 terminology contains common terms, definitions of terms, descriptions of terms, nomenclature, and acronyms associated with three-dimensional (3-D) imaging systems in an effort to standardize terminology used for 3-D imaging systems.

1.2 The definitions of the terms presented in 3.1 are obtained from various standard documents developed by various standards development organizations. The intent is not to change these universally accepted definitions but to gather, in a single document, terms and their definitions that may be used in current or future standards for 3-D imaging systems.

1.2.1 In some cases, definitions of the same term from two standards have been presented to provide additional reference. The text in parentheses to the right of each defined term is the name (and, in some cases, the specific section) of the source of the definition associated with that term.

1.3 The definitions in 3.2 are specific terms developed by this committee for 3-D imaging systems.

1.4 A definition in this terminology is a statement of the meaning of a word or word group expressed in a single sentence with additional information included in notes or discussions.

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

NOTE 1—The subcommittee responsible for this standard will review definitions on a five-year basis to determine if the definition is still appropriate as stated. Revisions will be made when determined necessary.

2. Referenced Documents

2.1 *ASTM Standard:*[2]

E 456 Terminology Relating to Quality and Statistics

2.2 *ASME Standard:*[3]

B89.4.19 Performance Evaluation of Laser Based Spherical Coordinate Measurement Systems

2.3 *ISO Standard:*[4]

VIM, International Vocabulary of Basic and General Terms in Metrology

2.4 *NIST/SEMATECH Standard:*[5]

NIST/SEMATECH e-Handbook of Statistical Methods

3. Terminology

3.1 *Definitions:*

accuracy of measurement, *n*—closeness of the agreement between the result of a measurement and a true value of the measurand. **(VIM 3.5)**

DISCUSSION—

(1) Accuracy is a qualitative concept.

(2) The term "precision" should not be used for "accuracy."

bias (of a measuring instrument), *n*—systematic error of the indication of a measuring instrument. **(VIM 3.25)**

DISCUSSION—The bias of a measuring instrument is normally estimated by averaging the error of indication over an appropriate number of repeated measurements.

bias, *n*—difference between the average or expected value of a distribution and the true value. **(NIST/SEMATECH e-Handbook)**

DISCUSSION—In metrology, the difference between precision and accuracy is that measures of precision are not affected by bias, whereas accuracy measures degrade as bias increases.

calibration, *n*—set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or

[1] This terminology is under the jurisdiction of Committee E57 on 3D Imaging Systems and is the direct responsibility of Subcommittee E57.01 on Terminology.
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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] Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Three Park Ave., New York, NY 10016-5990, http://www.asme.org.

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

[5] Available from National Institute of Standards and Technology (NIST), 100 Bureau Dr., Stop 1070, Gaithersburg, MD 20899-1070, http://www.nist.gov. e-Handbook available at http://www.itl.nist.gov/div898/handbook/.

values represented by a material measure or a reference material, and the corresponding values realized by standards. **(VIM 6.11)**

Discussion—

(1) The result of a calibration permits either the assignment of values of measurands to the indications or the determination of corrections with respect to indications.

(2) A calibration may also determine other metrological properties such as the effect of influence quantities.

(3) The result of a calibration may be recorded in a document, sometimes called a calibration certificate or a calibration report.

compensation, *n*—the process of determining systematic errors in an instrument and then applying these values in an error model that seeks to eliminate or minimize measurement errors. **(ASME B89.4.19)**

conventional true value (of a quantity), *n*—value attributed to a particular quantity and accepted, sometimes by convention, as having an uncertainty appropriate for a given purpose. **(VIM 1.20)**

Discussion—

(1) Examples: (*1*) at a given location, the value assigned to the quantity realized by a reference standard may be taken as a conventional true value and (*2*) the CODATA (1986) recommended value for the Avogadro constant, N_A: 6 022 136 7 × 10^{23} mol^{-1}.

(2) Conventional true value is sometimes called assigned value, best estimate of the value, conventional value, or reference value.

(3) Frequently, a number of results of measurements of a quantity is used to establish a conventional true value.

error (of measurement), *n*—result of a measurement minus a true value of the measurand. **(VIM 3.10)**

Discussion—

(1) Since a true value cannot be determined, in practice, a conventional true value is used (see true value and conventional true value).

(2) When it is necessary to distinguish "error" from "relative error," the former is sometimes called "absolute error of measurement." This should not be confused with the "absolute value of error," which is the modulus of error.

indicating (measuring) instrument, *n*—measuring instrument that displays an indication. **(VIM 4.6)**

Discussion—

(1) Examples include analog indicating voltmeter, digital frequency meter, and micrometer.

(2) The display may be analog (continuous or discontinuous) or digital.

(3) Values of more than one quantity may be displayed simultaneously.

(4) A displaying measuring instrument may also provide a record.

limiting conditions, *n*—the manufacturer's specified limits on the environmental, utility, and other conditions within which an instrument may be operated safely and without damage.

Discussion—The manufacturer's performance specifications are not assured over the limiting conditions.

maximum permissible error (MPE), *n*—extreme values of an error permitted by specification, regulations, and so forth for a given measuring instrument. **(VIM 5.21)**

measurand, *n*—particular quantity subject to measurement. **(VIM 2.6)**

Discussion—

(1) Example includes vapor pressure of a given sample of water at 20°C.

(2) The specification of a measurand may require statements about quantities such as time, temperature, and pressure.

precision, *n*—closeness of agreement between independent test results obtained under stipulated conditions. **(ASTM E 456)**

Discussion—

(1) Precision depends on random errors and does not relate to the true value or the specified value.

(2) The measure of precision is usually expressed in terms of imprecision and computed as a standard deviation of the test results. Less precision is reflected by a larger standard deviation.

(3) "Independent test results" means results obtained in a manner not influenced by any previous result on the same or similar test object. Quantitative measures of precision depend critically on the stipulated conditions. Repeatability and reproducibility conditions are particular sets of extreme stipulated conditions.

precision, *n—in metrology,* the variability of a measurement process around its average value. **(NIST/SEMATECH e-Handbook)**

Discussion—Precision is usually distinguished from accuracy, the variability of a measurement process around the true value. Precision, in turn, can be decomposed further into short-term variation or repeatability and long-term variation or reproducibility.

random error, *n*—result of a measurement minus the mean that would result from an infinite number of measurements of the same measurand carried out under repeatability conditions. **(VIM 3.13)**

Discussion—

(1) Random error is equal to error minus systematic error.

(2) Because only a finite number of measurements can be made, it is possible to determine only an estimate of random error.

rated conditions, *n*—manufacturer-specified limits on environmental, utility, and other conditions within which the manufacturer's performance specifications are guaranteed at the time of installation of the instrument. **(ASME B89.4.19)**

relative error, *n*—error of measurement divided by a true value of the measurand. **(VIM 3.12)**

Discussion—Since a true value cannot be determined, in practice a