

Standard Practice for Use of the Terms Precision and Bias in ASTM Test Methods¹

This standard is issued under the fixed designation E177; 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.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope

1.1 The purpose of this practice is to present concepts necessary to the understanding of the terms “precision” and “bias” as used in quantitative test methods. This practice also describes methods of expressing precision and bias and, in a final section, gives examples of how statements on precision and bias may be written for ASTM test methods.

1.2 *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 requirements prior to use.*

2. Referenced Documents

2.1 ASTM Standards:²

E456 Terminology Relating to Quality and Statistics

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

E1488 Guide for Statistical Procedures to Use in Developing and Applying Test Methods

E2282 Guide for Defining the Test Result of a Test Method

E2586 Practice for Calculating and Using Basic Statistics

E2587 Practice for Use of Control Charts in Statistical Process Control

3. Terminology

3.1 **Definitions**—Terminology E456 provides a more extensive list of terms in E11 standards.

3.1.1 **accepted reference value, n** —a value that serves as an agreed-upon reference for comparison, and which is derived as: (1) a theoretical or established value, based on scientific principles, (2) an assigned or certified value, based on experimental work of some national or international organization, or

(3) a consensus or certified value, based on collaborative experimental work under the auspices of a scientific or engineering group.

3.1.1.1 **Discussion**—A national or international organization, referred to in 3.1.1 (2), generally maintains measurement standards to which the reference values obtained are traceable.

3.1.2 **accuracy, n** —the closeness of agreement between a test result and an accepted reference value.

3.1.2.1 **Discussion**—The term accuracy, when applied to a set of test results, involves a combination of a random component and of a common systematic error or bias component.

3.1.3 **bias, n** —the difference between the expectation of the test results and an accepted reference value.

3.1.3.1 **Discussion**—Bias is the total systematic error as contrasted to random error. There may be one or more systematic error components contributing to the bias. A larger systematic difference from the accepted reference value is reflected by a larger bias value.

3.1.4 **characteristic, n** —a property of items in a sample or population which, when measured, counted or otherwise observed, helps to distinguish between the items. **E2282**

3.1.5 **coefficient of variation, CV, n** —for a nonnegative characteristic, the ratio of the standard deviation to the mean for a population or sample. **E2586**

3.1.6 **intermediate precision, n** —the closeness of agreement between test results obtained under specified intermediate precision conditions.

3.1.6.1 **Discussion**—The specific measure and the specific conditions must be specified for each intermediate measure of precision; thus, “standard deviation of test results among operators in a laboratory,” or “day-to-day standard deviation within a laboratory for the same operator.”

3.1.6.2 **Discussion**—Because the training of operators, the agreement of different pieces of equipment in the same laboratory and the variation of environmental conditions with longer time intervals all depend on the degree of within-laboratory control, the intermediate measures of precision are likely to vary appreciably from laboratory to laboratory. Thus, intermediate precisions may be more characteristic of individual laboratories than of the test method.

¹ This practice is under the jurisdiction of ASTM Committee E11 on Quality and Statistics and is the direct responsibility of Subcommittee E11.20 on Test Method Evaluation and Quality Control.

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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.