



Standard Practice for Process Capability and Performance Measurement¹

This standard is issued under the fixed designation E2281; 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 practice provides guidance for determining process capability and performance under several common scenarios of use including: (a) normal distribution based capability and performance indices such as C_p , C_{pk} , P_p , and P_{pk} ; (b) process capability using attribute data for non-conforming units and non-conformities per unit type variables, and (c) additional methods in working with process capability or performance.

2. Referenced Documents

2.1 *ASTM Standards*:²

E456 Terminology Relating to Quality and Statistics

E2334 Practice for Setting an Upper Confidence Bound For a Fraction or Number of Non-Conforming items, or a Rate of Occurrence for Non-conformities, Using Attribute Data, When There is a Zero Response in the Sample

2.2 *Other Document*:

MNL 7 Manual on Presentation of Data and Control Chart Analysis³

3. Terminology

3.1 *Definitions*—Unless otherwise noted, all statistical terms are defined in Terminology E456.

3.1.1 *long term standard deviation*, σ_{LT} , n —sample standard deviation of all individual (observed) values taken over a long period of time.

3.1.1.1 *Discussion*—A long period of time may be defined as shifts, weeks, or months, etc.

3.1.2 *process capability*, PC , n —statistical estimate of the outcome of a characteristic from a process that has been demonstrated to be in a state of statistical control.

3.1.3 *process capability index*, C_p , n —an index describing process capability in relation to specified tolerance.

3.1.4 *process performance*, PP , n —statistical measure of the outcome of a characteristic from a process that may not have been demonstrated to be in a state of statistical control.

3.1.5 *process performance index*, P_p , n —index describing process performance in relation to specified tolerance.

3.1.6 *short term standard deviation*, σ_{ST} , n —the inherent variation present when a process is operating in a state of statistical control, expressed in terms of standard deviation.

3.1.6.1 *Discussion*—This may also be stated as the inherent process variation.

3.1.7 *stable process*, n —process in a state of statistical control; process condition when all special causes of variation have been removed.

3.1.7.1 *Discussion*—Observed variation can then be attributed to random (common) causes. Such a process will generally behave as though the results are simple random samples from the same population.

3.1.7.2 *Discussion*—This state does not imply that the random variation is large or small, within or outside of specification, but rather that the variation is predictable using statistical techniques.

3.1.7.3 *Discussion*—The process capability of a stable process is usually improved by fundamental changes that reduce or remove some of the random causes present or adjusting the mean towards the preferred value, or both.

3.1.7.4 *Discussion*—Continual adjustment of a stable process will increase variation.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *lower process capability index*, C_{pk} , n —index describing process capability in relation to the lower specification limit.

3.2.2 *lower process performance index*, P_{pk} , n —index describing process performance in relation to the lower specification limit.

3.2.3 *minimum process capability index*, C_{pk} , n —smaller of the upper process capability index and the lower process capability index.

3.2.4 *minimum process performance index*, P_{pk} , n —smaller of the upper process performance index and the lower process performance index.

¹ This practice is under the jurisdiction of ASTM Committee E11 on Quality and Statistics and is the direct responsibility of Subcommittee E11.30 on Statistical Quality Control.

Current edition approved Oct. 1, 2015. Published October 2015. Originally approved in 2003. Last previous edition approved in 2012 as E2281 – 08a (2012)^{ε1}. DOI: 10.1520/E2281-15.

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 ASTM Headquarters, 100 Barr Harbor Drive, W. Conshohocken, PA 19428.