



Standard Practice for Calculating Sample Size to Estimate, With Specified Precision, the Average for a Characteristic of a Lot or Process¹

This standard is issued under the fixed designation E122; 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 This practice covers simple methods for calculating how many units to include in a random sample in order to estimate with a specified precision, a measure of quality for all the units of a lot of material, or produced by a process. This practice will clearly indicate the sample size required to estimate the average value of some property or the fraction of nonconforming items produced by a production process during the time interval covered by the random sample. If the process is not in a state of statistical control, the result will not have predictive value for immediate (future) production. The practice treats the common situation where the sampling units can be considered to exhibit a single (overall) source of variability; it does not treat multi-level sources of variability.

1.2 The system of units for this standard is not specified. Dimensional quantities in the standard are presented only as illustrations of calculation methods. The examples are not binding on products or test methods treated.

1.3 *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

E456 Terminology Relating to Quality and Statistics

¹ This practice is under the jurisdiction of ASTM Committee E11 on Quality and Statistics and is the direct responsibility of Subcommittee E11.10 on Sampling / Statistics.

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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. Terminology

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

3.1.1 *pooled standard deviation, s_p , n* —the estimate of a standard deviation derived by combining sample standard deviations of several samples, weighting squared standard deviations by their degrees of freedom.

3.2 *Symbols*—Symbols used in all equations are defined as follows:

- E = the maximum acceptable difference between the true average and the sample average.
- e = E/μ , maximum acceptable difference expressed as a fraction of μ .
- f = degrees of freedom for a standard deviation estimate (7.5).
- k = the total number of samples available from the same or similar lots.
- μ = lot or process mean or expected value of X , the result of measuring all the units in the lot or process.
- μ_0 = an advance estimate of μ .
- N = size of the lot.
- n = size of the sample taken from a lot or process.
- n_j = size of sample j .
- n_L = size of the sample from a finite lot (7.4).
- p' = fraction of a lot or process whose units have the nonconforming characteristic under investigation.
- p_0 = an advance estimate of p' .
- p = fraction nonconforming in the sample.
- R = range of a set of sampling values. The largest minus the smallest observation.
- R_j = range of sample j .
- $\bar{R}$ = $\sum_{j=1}^k R_j/k$, average of the range of k samples, all of the same size (8.2.2).
- σ = lot or process standard deviation of X , the result of measuring all of the units of a finite lot or process.
- σ_0 = an advance estimate of σ .
- s = $\left[\sum_{i=1}^n (X_i - \bar{X})^2 / (n - 1) \right]^{1/2}$, an estimate of the standard deviation σ from n observation, X_i , $i = 1$ to n .