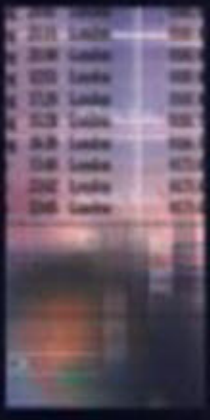
Glossary and Tables for Statistical Quality Control



Fourth Edition

ASQ Statistics Division

Glossary and Tables for Statistical Quality Control

Fourth Edition

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Fourth Edition

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Preface

This book began in 1954 as *Symbols, Definitions and Tables for Industrial Statistics and Quality Control*, an internal manual of the Eastman Kodak Company written by Kodak's Industrial Statistics Committee. This committee included quality giants such as Richard A. Freund, J. Edward Jackson, and Donald A. Wright. Kodak gave the Rochester Institute of Technology permission to reproduce and publish the manual, and we continue to build on this legacy as we strive to continue the advancement of practical statistics with a fourth edition of the manual.

What to keep, what to set aside, and what to alter was a challenge to the fourth edition team. Originally, the manual contained many tables, but because of advances in computer technology most of the tables are no longer needed. Therefore, we kept only the standard tables generally found in current statistics textbooks.

We gratefully thank Minitab for their policy allowing use of Minitab software to make calculations. Because of the ability of Minitab and other software to make the needed calculations, we did not include many of the detailed equations that were in previous editions.

The numerous sources we used for this revision are listed in the references. We frequently rewrote definitions so that a wider audience could grasp the meaning of the technical terms, but the definitions would still be technically correct. The third edition made a bold change in format by alphabetizing the terms rather than grouping them by subject. We expanded this concept by weaving the Glossary of Symbols into the listing of the terms. Rather than have an index, we cross-referenced the terms extensively and added a Control Chart Guide. The team investigated adding Six Sigma terms, but found that the statistical terms involved were already included.

The ASQ Statistics Division gave tremendous encouragement and support to the team. Bob Mitchell, Statistics Division Chair 2002–03, was always available. Annemieke Hytinen, ASQ Quality Press Acquisitions Editor, provided assistance on numerous questions. James Bossert, third edition editor, gave initial support.

The dedicated team members who worked continuously with me were Georgia Kay Carter, Willis Jensen, Herb Monnich, and Glen Page.

Rudy Kittlitz
Editor

Acknowledgments

ASQ and the Statistics Division appreciate the contributions of the authors of this revision. They are:

Georgia Kay Carter

Willis Jensen

Rudolf G. Kittlitz, Jr. (Chair)

Herbert Monnich, Jr.

Glen Page

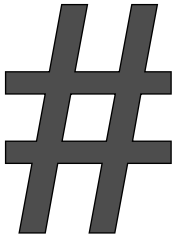
I

Glossary of Terms

To make this section more user friendly, numbers and symbols have been included in the alphabetization under the following guidelines:

- Numbers precede letters and are not alphabetized by their spelled-out equivalent.
- Greek letters are alphabetized as their closest English equivalent, and precede the English. Example: α precedes a; β precedes b; χ precedes x.
- Subscripts and superscripts are ignored.

Cross-references to other terms are indicated by italics.



$1 - \alpha$ See *confidence level.*

$1 - \beta$ The power of testing a hypothesis is $1 - \beta$. It is the probability of correctly rejecting the *null hypothesis*, H_0.[26]

2^k factorial design A *factorial design* in which *k factors* are studied, each of them at exactly two *levels.*[19]

100 percent inspection An inspection of selected *characteristic*(s) of every *item* in the group under consideration.[18]

A

α (alpha) 1: The maximum probability, or risk, of making a *type I error* when dealing with the *significance level* of a test.
2: The *probability* or risk of incorrectly deciding that a shift in the process mean has occurred when the process is unchanged (when referring to α in general or as the *p-value* obtained in a test).
3: α is usually designated as producer's risk.[12]

Ac See *acceptance number.*

Acceptable process level (APL) The process level that forms the outer boundary of the zone of acceptable processes. (A process located at the APL will have only a *probability of rejection* designated α when the plotted statistical measure is compared to the acceptance control limits.)

Note: In the case of two-sided tolerances, upper and lower acceptable process levels will be designated UAPL and LAPL. (These need not be symmetrical around the standard level.)[4]

Acceptable process zone See *zone of acceptable process.*

Acceptance (control chart or acceptance control chart usage)

A decision that the *process* is operating in a satisfactory manner with respect to the *statistical measure* being plotted.[4]

Acceptance control chart

A *control chart* intended primarily to evaluate whether or not the plotted measure can be expected to satisfy specified *tolerances.*[18]

Acceptance control limit (ACL)

Control limits for an *acceptance control chart* that permit some assignable shift in process level based on specified requirements, provided within-*subgroup* variability is in a *state of statistical control.*[18]

Acceptance number (Ac)

The largest number of *nonconformities* or nonconforming items found in the *sample* by *acceptance sampling inspection by attributes* that permits the acceptance of the lot as given in the *acceptance sampling plan.*[18]

Acceptance quality limit (AQL)

The AQL is the *quality* level that is the worst tolerable product average when a continuing series of lots is submitted for *acceptance sampling.*

Note 1: This concept only applies when an *acceptance sampling scheme* with rules for switching and for discontinuation is used.

Note 2: Although individual lots with quality as bad as the acceptance quality limit can be accepted with fairly high probability, the designation of an acceptance quality limit does not suggest that this is a desirable quality level.

Note 3: *Acceptance sampling schemes* found in standards, with their rules for switching and

for discontinuation of sampling inspection, are designed to encourage suppliers to have process averages consistently better than the acceptance quality limit. If suppliers fail to do so, there is a high probability of being switched from *normal inspection* to *tightened inspection*, where *lot* acceptance becomes more difficult. Once on tightened inspection, unless corrective action is taken to improve product quality, it is very likely that the rule requiring discontinuance of sampling inspection will be invoked.

Note 4: The use of the abbreviation AQL to mean acceptable quality level is no longer recommended since modern thinking is that no fraction defective is really acceptable. Using "acceptance quality limit" rather than "acceptable quality level" indicates a technical value where acceptance occurs.[2, 3]

Acceptance sampling — A sampling after which decisions are made to accept or not to accept a *lot*, or other grouping of product, material, or service, based on sample results.[18]

Acceptance sampling inspection — An acceptance *inspection* where the acceptability is determined by sampling *inspection*.[18]

Acceptance sampling inspection by attributes — An *acceptance sampling inspection* whereby the presence or absence of specified *characteristics* of each item in a sample is observed to statistically establish the acceptability of a *lot* or *process*.[18]

Acceptance sampling inspection by variables — An *acceptance sampling inspection* in which the acceptability of a *process* is determined statistically from measurements on specified

quality *characteristics* of each item in a *sample* from a *lot.*

Note: Lots taken from an acceptable process are assumed to be acceptable.[18]

Acceptance sampling inspection system

A collection of *acceptance sampling plans* or *acceptance sampling schemes* together with criteria by which appropriate plans or schemes may be chosen.[18]

Acceptance sampling plan

A plan that states the *sample size(s)* to be used and the associated criteria for *lot* acceptance.[18]

Acceptance sampling procedure

The operational requirements and/or instructions related to the use of a particular *acceptance sampling plan.*

Note: This covers the planned method of selection, withdrawal, and preparation of *sample(s)* from a *lot* to yield knowledge of the *characteristic*(s) of the lot.[18]

Acceptance sampling scheme

The combination of *acceptance sampling plans* with *switching rules* for changing from one plan to another.[18]

Acceptance sampling system

A collection of sampling schemes.[14]

Accessibility

A measure of the relative ease of admission to the various areas of a piece of equipment for the purpose of operation or maintenance.[24]

Accuracy

The closeness of agreement between a test result or measurement result and the true value.[18]