



AEROSPACE STANDARD	AS9138™	
	Issued	2018-01
	Supersedes ARP9013	
	Technically equivalent writings published in all IAQG sectors.	
Aerospace Series - Quality Management Systems Statistical Product Acceptance Requirements		

RATIONALE

This standard is an upgrade and replacement for the Aerospace Recommended Practice (ARP) 9013-series of documents (i.e., ARP9013, ARP9013/1, ARP9013/2, ARP9013/3, ARP9013/4) prepared and published by the Americas Aerospace Quality Group (AAQG) in 2005. Technically equivalent standards are published in all International Aerospace Quality Group (IAQG) sectors (i.e., Americas, Asia-Pacific, Europe). Reasons for publishing this standard include the following:

1. Quality Engineers and planners within many organizations which utilized sampling standards, prior to the publishing of the ARP9013-series of documents, found previous standards difficult to interpret and/or to implement correctly. The IAQG recognized this situation and chartered a committee in 2001 to develop a new sampling standard. The assignment to write a new statistical standard was given to the Americas sector of the IAQG with the stated strategy that once the new document was published and tested in the AAQG, it would be brought back to the IAQG for global implementation.
2. The ARP9013-series of documents was published in 2005 to be simpler than existing legacy standards. It also marked a transition from legacy statistical product acceptance requirement documents that were organized around a measure of producer protection rather than consumer protection. To accomplish this without extreme increases in inspection required the simultaneous introduction of new statistical tools and tables.
3. After experience gained from the initial release of the ARP9013-series of documents, the IAQG believed that the goals of simpler and more effective statistical methods for Quality Engineers and planners had been achieved, but that further improvements were possible, both in the development of new tools and in providing further detail/clarifications within the writing.
4. Furthermore, there have been changes in the 9100/9110/9120 quality management system standards relative to the language associated to statistical product acceptance. This 9138 standard incorporates those changes.

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FOREWORD

To assure customer satisfaction, the aviation, space, and defense industry organizations produce, and continually improve, safe, reliable products that meet or exceed customer and regulatory authority requirements. The globalization of the aerospace industry and the resulting diversity of regional/national requirements and expectations have complicated this objective. End-product organizations face the challenge of integrating and assuring the quality of product purchased from suppliers throughout the world and at all levels within the supply chain, while suppliers and processors face the challenge of delivering product to multiple customers having varying quality expectations and requirements.

The aerospace industry established the IAQG for the purpose of achieving significant improvements in quality and safety, and in reduced costs throughout the value stream. This organization includes representation from aerospace companies in the Americas, Asia/Pacific, and Europe. This standard has been prepared by the IAQG.

This document standardizes and streamlines, to the greatest extent possible, the requirements and flexible resources on statistical techniques for product acceptance across the diversity of aerospace industry processes. The establishment of common requirements, for use at all levels of the supply-chain by organizations around the world, should result in improved quality and safety, and decreased costs due to the elimination or reduction of organization-unique requirements and the resultant variation inherent in these multiple expectations.

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INTRODUCTION

This standard establishes the general requirements applicable to any method of statistical product acceptance to reduce inspection costs while still assuring acceptable quality. There is no single specific plan that can be considered best suited for all applications or processes.

This document applies only to statistical methods used for product acceptance and does not apply to statistical methods that are not related to product acceptance. Many companies use excellent statistical methods solely to monitor and to improve their product quality, and those methods are not subject to the requirements of this document.

Products which are eligible for the methods defined in this standard include, but are not limited to: end items, cast, forged, wrought, machined, fabricated, plastic, molded, powdered metal, or stamped components and raw material; electronic, electrical, and mechanical components.

0.1 Paradigm of Quality Requirements and Product Acceptance Plans

Figure 1 shows how requirements and acceptance strategies come together to develop a product acceptance plan.

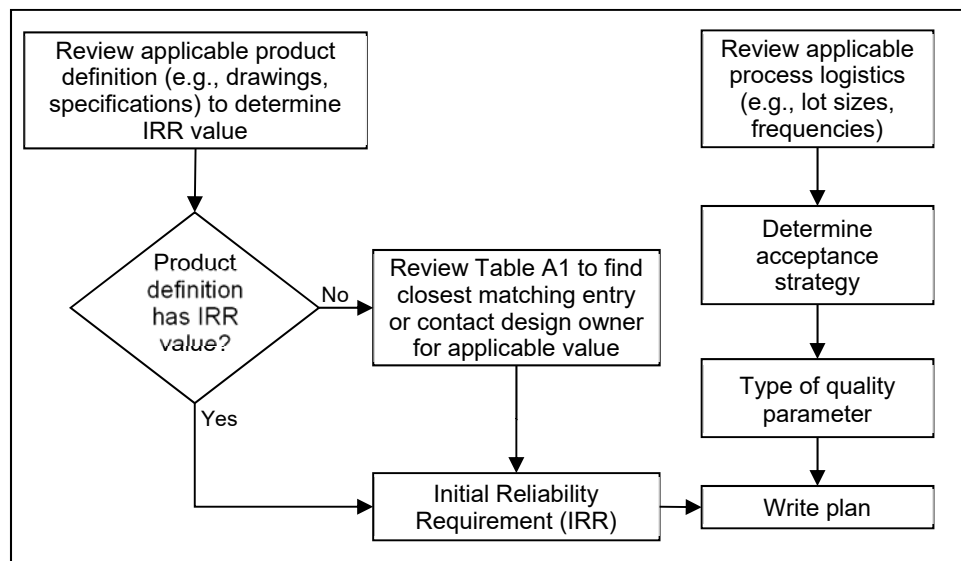


Figure 1 - Engineering and operations inputs into product acceptance plan

0.1.1 Engineering

Each product is engineered to meet functionality and reliability goals. Engineering provides requirements that are needed to meet the goals. Assessment of the goals involves statistics. To compare the goals with engineering requirements requires a statistical benchmark. This document expresses the engineering requirement as an Initial Reliability Requirement (IRR) or Inspection Reliability Requirement. The IRR defines a minimum acceptable outgoing yield or probability of conformance.

It is recommended by regulatory authorities that, "Engineering and manufacturing organizations should participate in the review, implementation, and maintenance of statistical quality/process control techniques used for product or article acceptance" [reference Federal Aviation Administration (FAA) Advisory Circular (AC) 21-43].

If Engineering does not provide a specific protection value (e.g., IRR), then the values in Appendix A (see Table A1) are provided as conventional levels of protection.

0.1.2 Operations

The attainment of product functionality and reliability goals involves several kinds of production logistics. Product may be produced in batches, large or small lots, continuous processes, or single-piece flow manufacturing processes. Assessments of the product may occur in receiving inspection, in-process inspections, final inspection, or in-storage inspection. The statistical product acceptance requirements for each kind of production logistics are documented in separate sections of this document. Each section cites one or more quality parameters that are used to verify that produced parts meet the Engineering IRR.

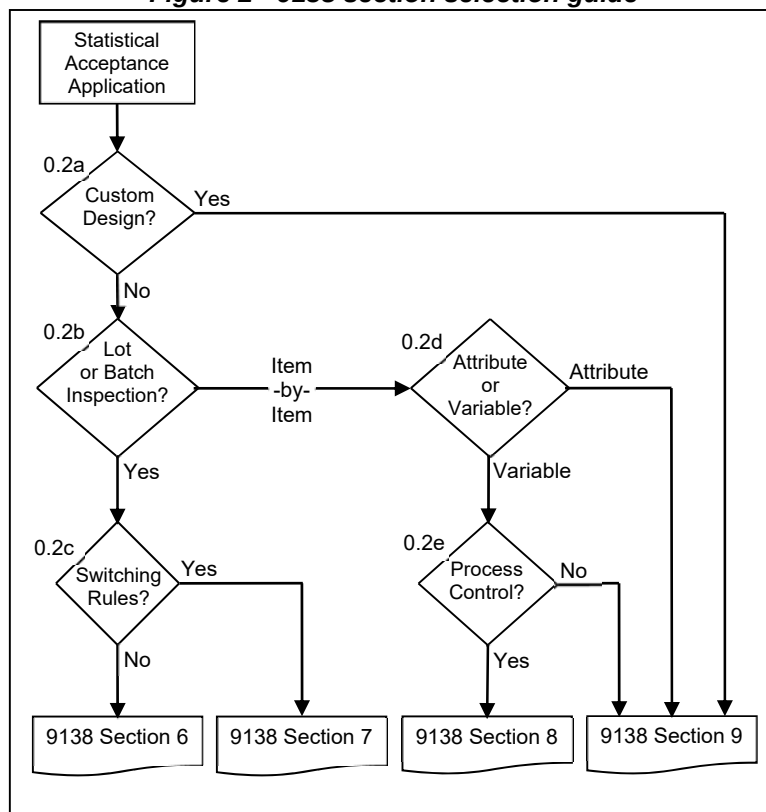
Manufacturing and/or inspection should provide the range of lot sizes and frequencies that are expected to be used to produce the subject product. Additional information from these organizations should include measurement accuracy (see 4.7), randomization tools (see 4.5), product retrievability limits (see 4.8), and available resources for training, auditing, and records (see 4.2, 4.11, and 4.9 respectively).

Product may be accepted as one or more isolated lots under the instructions of Section 6; sample sizes may be adjusted from lot-to lot based on the history of lot rejections under the instructions of Section 7; product may be accepted based on process controls under the instructions of Section 8; and product may be accepted one unit at a time or by other advanced methods under the instructions of Section 9. Each section has further explanations and guidance in an associated appendix. There are also guidance and sampling tables relating to these sections in the Supply Chain Management Handbook (SCMH) published online by the IAQG.

0.2 Acceptance Method Considerations

Selecting which of 9138 Sections 6, 7, 8, or 9 is most appropriate for a statistical product acceptance application depends on the answers to the five decision diamonds (see Figure 2). Each section covers a family of statistical techniques and their associated quality parameters; Figure 2 presents how the decisions result in the selection of the most appropriate section.

Figure 2 - 9138 section selection guide



- a. In the first decision diamond, the question is whether the specific statistical tool is drawn from published sources (e.g., SCMH) or whether the organization intends to develop their own method; this recognizes that the 9138 standard allows for the development of new methods. The skill level for doing this requires competency with the mathematical tools in the definitions section of this document, support from individuals knowledgeable about the measurement or evaluation processes, and support from individuals who understand the consequences of nonconformances (these should include design authority individuals).
- b. In the second decision diamond, the question is whether the product in question is to be accepted one unit at a time versus being accepted in lots or batches. This decision may be affected by “Economic Order Quantity” mathematics or by direct contractual stipulation.
- c. In the third decision diamond, the question is associated with the use of switching rules. For many years, most sampling standards required users to keep track of their records of previous accepted and rejected lots from each sampled process, and to increase or to decrease the sample sizes in response to the process history. The rules for increasing or decreasing the amount of inspection were called “switching rules”. Switching rules may be helpful in processes that have long production runs, stable quality, relatively large lots, and good computing support to handle the administrative details. Switching rules are also sometimes required by contractual reference to legacy standards. In other cases, the simplicity of individual lot sampling plans may offset the potential savings of using more complicated switching rules.
- d. The fourth decision diamond asks whether the product quality is evaluated on an attribute or variables basis. This question depends primarily on the level of computing and administrative resources available, because variables data involves collecting the detailed measurements of every accepted feature. The additional information from variables sampling does allow for fewer inspections to be performed, so the tradeoff would usually apply variables inspection to products with few characteristics and very high inspection costs per unit.
- e. The last decision diamond asks whether process controls alone will control the probability of an escape to the customer.

1. SCOPE

1.1 Purpose

This standard establishes requirements when implementing statistical product acceptance methods to meet defined risk requirements. This standard also establishes the minimum content required to be covered in an organization's documented procedures that govern their application of statistical product acceptance methods.

These general requirements and documented procedures apply the requirements of the 9100/9110/9120 quality management system standards, in addition to establishing requirements for retrievability, safety/critical characteristics, and quality parameters that protect the customer.

1.2 Application

This standard is applicable when invoked in a purchasing contract or specification, contractual document, customer agreement, or adopted by the organization. The purchase contract/agreement may or may not identify the appropriate 9138 section(s) to be applied by the organization. All statistical methods of product acceptance require the use of Sections 4 and 5.

To accept product produced:

- by individual lots, see Section 6;
- under switching rules, see Section 7;
- under process controls, see Section 8; and
- by continuous sampling or special case methods, see Section 9.

2. REFERENCES

The following referenced documents are valuable for the application of specific tools presented in this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies. When a conflict in requirements between this document and the referenced standards/related writings exists, the requirements of this document shall take precedence; however, nothing in this document supersedes applicable laws, regulations, and contractual requirements.

2.1 Normative References

- 9100* Quality Management Systems – Requirements for Aviation, Space and Defense Organizations
- 9110* Quality Management Systems – Requirements for Aviation Maintenance Organizations
- 9120* Quality Management Systems – Requirements for Aviation, Space and Defense Distributors

Supply Chain Management Handbook (see <http://www.sae.org/iaqg/>)

* As developed under the auspice of the IAQG and published by various standards bodies [e.g., Aerospace and Defense Industries Association – Standardization (ASD-STAN), SAE International, European Committee for Standardization (CEN), Japanese Standards Association (JSA)/Society of Japanese Aerospace Companies (SJAC), Brazilian Association for Technical Norms (ABNT)].

NOTE: References to specific 9100/9110/9120 revision dates are included in this document in order to allow for the corresponding standard clause numbers to be identified and to recognize the potential for future changes to these standards; however, the applicable clause(s) from the latest revision have precedence.

2.2 American National Standards Institute Accredited Publications

Copies of these documents are available online at <http://webstore.ansi.org/>.

Available from American Society for Quality (ASQ), 600 North Plankinton Avenue, Milwaukee, WI 53203, Tel: 800-248-1946 (United States or Canada), 001-800-514-1564 (Mexico) or +1-414-272-8575 (all other locations), www.asq.org.

ANSI/ASQ Z1.4 Sampling Procedures and Tables for Inspection by Attributes

ANSI/ASQ Z1.9 Sampling Procedures and Tables for Inspection by Variables for Percent Nonconforming

ANSI/ASQC B1 Guide for Quality Control Charts

ANSI/ASQC B2 Control Chart Method of Analyzing Data

ANSI/ASQC B3 Control Chart Method of Controlling Quality During Production

ANSI/ASQC S1 An Attribute Skip-Lot Sampling Program

2.3 Federal Aviation Administration Publications

Available from Federal Aviation Administration (FAA), 800 Independence Avenue SW, Washington, DC 20591, Tel: 866-835-5322, www.faa.gov.

AC21-43 Issuance of Production Approvals Under Subparts G, K, and O

2.4 International Organization for Standardization Publications

Available from International Organization for Standardization, ISO Central Secretariat, 1, ch. de la Voie-Creuse, CP 56, CH-1211 Geneva 20, Switzerland, Tel: +41 22 749 01 11, www.iso.org.

ISO 2859-1	Sampling procedures for inspection by attributes – Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection
ISO 2859-3	Sampling procedures for inspection by attributes – Part 3: Skip-lot sampling procedures
ISO 3951-1	Sampling procedures for inspection by variables – Part 1: Specification for single sampling plans indexed by acceptance quality limit (AQL) for lot-by-lot inspection for a single quality characteristic and a single AQL
ISO 9000	Quality management systems – Fundamentals and vocabulary
ISO 10576-1	Statistical methods – Guidelines for the evaluation of conformity with specified requirements – Part 1: General principles
ISO 11462-1	Guidelines for implementation of statistical process control (SPC) – Part 1: Elements of SPC
ISO 11462-2	Guidelines for implementation of statistical process control (SPC) – Part 2: Catalogue of tools and techniques
ISO/IEC Guide 98-1	Uncertainty of measurement – Part 1: Introduction to the expression of uncertainty in measurement
ISO/IEC Guide 98-3	Uncertainty of measurement – Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)
ISO/IEC Guide 98-4	Uncertainty of measurement – Part 4: Role of measurement uncertainty in conformity assessment

2.5 Japanese Standards

Available from Japanese Standards Association (JSA), Mita MT Bldg., 3-13-13 Mita, Minato-ku, Tokyo, 108-0073, Japan, Tel: +81-3-4231-8503, <http://www.jsa.or.jp/>.

JISZ9003:1979	Single sampling inspection plans having desired operation characteristics by variables (standard deviation known)
JISZ9004:1983	Single sampling inspection plans having desired operating characteristics by variables (standard deviation unknown and single limit specified)
JISZ9010:1999	Sequential sampling plans for inspection by variables for percent nonconforming (known standard deviation)
JISZ9015-0:1999	Sampling procedures for inspection by attributes – Part 0: Introduction to the JISZ9015 attribute sampling system
JISZ9015-1:2006	Sampling procedures for inspection by attributes – Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection
JISZ9015-3:1999	Sampling procedures for inspection by attributes – Part 3: Skip-lot sampling procedures
JISZ9020-1:2011	Control charts – Part 1: General guidelines
JISZ9021:1998	Shewhart control charts
JISZ9041-1:1999	Statistical interpretation of data – Part 1: Statistical presentation of data

JISZ9041-2:1999	Statistical interpretation of data – Part 2: Techniques of estimation and test relating to means and variances
JISZ9041-3:1999	Statistical interpretation of data – Part 3: Tests and confidence intervals relating to proportions
JISZ9041-4:1999	Statistical interpretation of data – Part 4: Power of tests relating to means and variances
JISZ9041-5:1999	Statistical interpretation of data – Part 5: Median - Estimation and confidence intervals

2.6 Published Books and Periodicals

“Certified Reliability Engineer Primer”, 4th Edition (October 1, 2009); Quality Council of Indiana; page VI-21

“DataMyte Handbook: Practical Guide to Computerized Data Collection for Statistical Process Control”, Sixth Edition (1995); published by DataMyte Corporation, Allen-Bradley Company, Inc.

“Empirical Bayes Theory”; Kotz, Johnson, and Read; Encyclopedia of Statistical Sciences, Volume 2

“How and When to Perform Bayesian Acceptance Sampling”; Thomas W. Calvin; ASQC Basic References in Quality Control: Statistical Techniques, Volume 7

“Measurement System Analysis Reference Manual”, 4th Edition (2010); Automotive Industry Action Group (AIAG), see www.aiag.org

“Potential Failure Mode and Effects Analysis”, 4th Edition (2008); Automotive Industry Action Group (AIAG), see www.aiag.org

“Potential Failure Mode and Effects Analysis for Tooling and Equipment”, 2nd Edition (2012); Automotive Industry Action Group (AIAG), see www.aiag.org

“Probability and Statistics for Engineers”, 2nd Edition (1986); R.L. Scheaffer and J.T. McClave; PWS Publishers, Duxbury Press; pages 280-281

“Quality Control and Industrial Statistics”, 5th Edition (1986); Acheson Duncan; published by Irwin, Homewood, IL

“Sequential Analysis”; Abraham Wald; published by John Wiley and Sons, Inc.; 1947

“The Mathematical Background of QSTAG 340”; American-British-Canadian-Australian Armies Standardization Program, Quadripartite Advisory Publication 16; pages VI-2 and VI-3

“Zero Acceptance Number Sampling Plans”; N. L. Squeglia; ASQ Quality Press

2.7 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

ARP4761	Guidelines and Methods for Conducting the Safety Assessment Process on Civil Airborne Systems and Equipment
ARP5580	Recommended Failure Modes and Effects Analysis (FMEA) Practices for Non-Automobile Applications
ARP9013	Statistical Product Acceptance Requirements
ARP9013/1	Statistical Product Acceptance Requirements Using Isolated Lot Sampling Methods
ARP9013/2	Statistical Product Acceptance Requirements Using Attribute or Variable Lot Acceptance Sampling Plans

ARP9013/3	Statistical Product Acceptance Requirements Using Process Control Methods
ARP9013/4	Statistical Product Acceptance Requirements Using Continuous Sampling, Skip-Lot Sampling, or Methods for Special Cases
SAE J1739	Potential Failure Mode and Effects Analysis in Design (Design FMEA), Potential Failure Mode and Effects Analysis in Manufacturing and Assembly Processes (Process FMEA)

2.8 Standardization Administration of China Publications

Available through Standardization Administration of the People's Republic of China (SAC), <http://www.sac.gov.cn/sacen/>, controlled by a Technical Committee of SAC (TC21-Application of Statistical Methods), contact Ding Wenxing, e-mail: dingwx@cnis.gov.cn.

GB/T 2828.1	Sampling procedures for inspection by attributes – Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection
GB/T 2828.3	Sampling procedures for inspection by attributes – Part 3: Skip-lot sampling procedures
GB/T 6378.1	Sampling procedures for inspection by variables – Part 1: Specification for single sampling plans indexed by acceptance quality limit (AQL) for lot-by-lot inspection for a single quality characteristic and a single AQL

2.9 United States Military Standards

Copies of these documents are available online at <http://quicksearch.dla.mil>.

MIL-HDBK-1823	Nondestructive Evaluation System Reliability Assessment
MIL-STD-105	Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-414	Sampling Procedures and Tables for Inspection by Variables for Percent Defective
MIL-STD-1235C	Single and Multilevel Continuous Sampling Procedures and Tables for Inspection by Attributes

NOTE: MIL-STD-1235 has been cancelled, but can be used as a guide for derivation and application of continuous sampling plans. The SCMHS contains the essential text and tables of MIL-STD-1235C with some editing, reformatting, and paragraph renumbering.

3. TERMS AND DEFINITIONS

An acronym log for this standard is presented in Appendix B. For the purposes of this standard, the following terms and definitions apply and can be supplemented by ISO 9000 definitions:

3.1 Acceptable Quality Level (AQL) [also referred to as Acceptance Quality Limit]

The maximum percentage or proportion of nonconforming units in a lot or batch that, for purposes of acceptance sampling, would be considered satisfactory as a process average.

3.2 Acceptance Sampling

Inspection in which decisions are made to accept or not accept a lot (or other grouping of product or material), based on the results of a sample or samples selected from that lot or grouping.

3.3 Analysis of Variance (ANOVA)

An arithmetic process developed for the purpose of comparing several sample means by partitioning the total variation of a set of data into components associated with recognized sources of variation.

3.4 Attribute Data

Qualitative data that counts the presence or absence of a characteristic evaluated to a specified criterion, rather than data from a continuous measurement scale.

NOTE: Attribute data is typically measured on a go/no-go, pass/fail, or yes/no basis.

3.5 Average Outgoing Quality (AOQ)

The average quality of outgoing product, after sampling inspection, for a given steady value of incoming product quality.

3.6 Average Outgoing Quality Limit (AOQL)

Maximum AOQ over all possible values of incoming product quality level for a given acceptance sampling plan.

3.7 Average Run Length (ARL)

The average number of plotted points on a control chart or the average number of items inspected before a shift in process level can be expected to be signaled (e.g., a point plotting outside the control limits).

3.8 Batch

Same as a "lot" or "grouping".

3.9 Bernoulli Trials Model

A model where a trial has exactly two possible outcomes (i.e., success and failure) and the probability of success is the same every time the experiment is conducted.

$$x_{\text{Bernoulli}} = \begin{cases} 1, & \text{if } x \text{ occurred} \\ 0, & \text{if } x \text{ did not occur} \end{cases} \quad (\text{Eq. 1})$$

$$\Pr(x_{\text{Bernoulli}}) = \begin{cases} p, & \text{if } x \text{ occurred} \\ 1-p, & \text{if } x \text{ did not occur} \end{cases} \quad (\text{Eq. 2})$$

$$\text{Bernoulli}(x; p) = p^x (1-p)^{1-x}, \quad x = 0, 1 \quad (\text{Eq. 3})$$

3.10 Binomial Distribution

The distribution of counts of successes (or failures) in a number of trials when there are only two kinds of outcomes and the probability of a success (or failure) is constant for all trials (i.e., the trials are independent).

$$b(k; p, n) = \sum_n x_{\text{Bernoulli}} = \binom{n}{k} (p^k) (1-p)^{n-k} \quad (\text{Eq. 4})$$

$b(k; p, n)$ = the probability of k nonconforming items in n trials

n = the fixed number of Bernoulli trials

k = the number of nonconforming units in n trials

p = the probability of a nonconforming unit; and $1-p$ is the probability of a conforming unit

NOTE: The binomial distribution results from summing repeated Bernoulli trials.

3.11 C=0 (C is equal to zero)

An acceptance sampling plan that requires rejection of the lot, batch, or grouping if the sample contains one or more nonconformances.

NOTE: The variable “C” stands for the number of nonconformances in a sample that allows acceptance of the lot.

3.12 Capability

The natural limits of a process. Typically, the range of six standard deviations of the values in a process having no changes in its mean or any other characteristic of its distribution; the inherent variation in a stable process. More precisely, a metric that characterizes the output of a stable process following a statistical distribution.

NOTE: For purposes of establishing a natural variation limit, the distribution is of a continuous variable.

a. An analysis of a process that compares the output process with some criteria for conformity.

$$C_p \equiv \frac{USL - LSL}{6s} \quad (\text{Eq. 5})$$

$$C_{pk} \equiv \text{Min} \left(\frac{\bar{x} - LSL}{3\sigma}, \frac{USL - \bar{x}}{3\sigma} \right) \quad (\text{Eq. 6})$$

NOTE 1: Continuous variables analyses compare a model distribution with specifications.

NOTE 2: C_p and C_{pk} translations to a probability of conformance commonly depend on a normal distribution. The appropriateness of the normal distribution is to be verified.

b. For the case of attribute data, it is usually defined as the average proportion or rate of defects or defectives (e.g., centerline of an attribute control chart).

NOTE: The Bayesian estimator for the defect rate when no defects are observed in the current sample and the prior distribution adds no information is Equation 7.

$$\Pr(d) = \frac{1}{n+2} \quad (\text{Eq. 7})$$

where:

$\Pr(d)$ = the probability of a defect (the defect rate)

n = the number of representative observations of the process, no defects observed (see “Probability and Statistics for Engineers” by R.L. Scheaffer and J.T. McClave)

3.13 Combinations

The number of distinct groupings of m distinct objects taken “ i ” at a time, where order of selection is immaterial (e.g., 123, 321, 213).

$$\binom{m}{i} = \frac{m!}{i! \times (m-i)!} \quad (\text{Eq. 8})$$

where:

$$m! = (m) \times (m-1) \times (m-2) \times \dots \times (3) \times (2) \times (1)$$

3.14 Conformance

When a characteristic of a product or process meets its requirements; fulfillment of specified requirements.

3.15 Consumer Risk

The probability that a lot with a fraction of nonconforming material equal to a stated index value will be accepted by a sampling plan.

3.16 Continuous Sampling

Inspection intended for application on the continuous flow of individual items of product that involves acceptance or non-acceptance on a unit-by-unit basis for the applicable characteristics using periods of one-hundred percent (100%) inspection and periods of sampling, depending on the quality of the observed product (see the SCM_H).

3.17 Critical Characteristic (also referred to as Safety Characteristic or Safety Critical Characteristic)

A characteristic designated with the words “critical” or “safety” by the design authority, where the responsibility for its definition is outside the scope of this standard.

3.18 Customer

The buying entity that is the issuer of a contract to a supplier.

NOTE: All aviation, space, and defense suppliers are also customers to their suppliers. Protection to the customer is the key goal of this standard.

3.19 Defect

Non-fulfillment of a requirement related to an intended or a specified use. A departure of a quality characteristic from its intended level or state that occurs with a severity sufficient to cause an associated product or service not to satisfy intended normal or foreseeable usage requirements.

NOTE: This is different from a nonconformance.

3.20 Determine

To decide conformity in a way that achieves the level of probability of conformance in accordance with the applicable quality parameter.

3.21 Equal Risk Point (ERP)

The fraction nonconforming at which the probability of rejecting a lot is fifty percent (also noted as $p_{.50}$).

NOTE: At this fraction nonconforming, the risk to the producer and consumer are the same. When no integer number of nonconforming units produces exactly 50% probability of acceptance, the ERP for that sample size is computed as the weighted average of the two nearest points on its discrete Operating Characteristic (OC) curve (see Appendix C (C.2.2)).

3.22 Escapement (also referred to as an Escape)

Nonconformities that were produced, not detected and remedied, and subsequently sent to the customer.

3.23 Expected Outgoing Quality (EOQ)

The probability that a unit accepted by sampling inspection is nonconforming, given both the sampling plan and a statement of what quality patterns have been demonstrated for the process.

NOTE: An EOQ can only be computed if there is a distribution, whether based upon parameters or an empirical distribution.

3.24 Gage Repeatability and Reproducibility (Gage R&R)

A study used to determine the degree of variability within a measurement system, and to separate this variability into components associated with the gage and the use of the gage.

3.25 Grouping

Same as a "lot" or "batch".

3.26 Homogeneity (also referred to as Homogeneous)

When applied to a process, homogeneity is where there is repetitive production running under the same conditions with similar behavior. Theoretical homogeneity is distinct from practical homogeneity:

- a. "Practical homogeneity": where all units of product are made according to the same design requirements under stable consistent conditions of production; a fixed process.

NOTE: Fixed processes will have identifiable streams or groups of product according to type, grade, class, size, composition, or other conditions of manufacture that could cause inconsistencies.

- b. "Theoretical homogeneity": the state of having identical cumulative distribution functions or values.

3.27 Hypergeometric Distribution

A discrete probability distribution that describes the number of items of interest found in a sample taken from a finite population.

NOTE: The probability describes sampling without replacement. Applies whenever one is computing the probability of accepting a single finite lot and it is especially valuable when the sample is large compared to the population.

$$\Pr [X = x] = \frac{\binom{M}{x} \binom{N-M}{n-x}}{\binom{N}{n}} \quad (\text{Eq. 9})$$

where:

$x = 0, 1, 2, \dots, \text{min. of } n \text{ or } M$

$N = 1, 2, \dots$ (population size)

$M = 0, 1, 2, 3, \dots, N$ (occurrences in population)

$n = 1, 2, \dots, N$ (sample size)

$$\binom{M}{x} = \frac{M!}{(x!)(M-x)!}$$

3.28 Initial Reliability Requirement (IRR) (also referred to as Inspection Reliability Requirement)

The minimum probability of conformance for each unit of product accepted through the associated sampling plan for design purposes.

3.29 Inspection

The process of measuring, examining, testing, gauging, or otherwise comparing product or material with requirements and determining conformance.

3.30 Isolated Lot

A lot which is accepted solely on the basis of information derived from within itself; separate from the sequence of lots in which it was produced or collected, and not depending on information from any other part of a current sequence of inspection lots.

3.31 Limiting Quality (LQ) [also referred to as the Lot Tolerance Percent Defective (LTPD), Lot Quality Protection (LQP), Unacceptable Quality Level (UQL), and Limiting Quality Level (LQL)]

A quality parameter that is the fraction nonconforming in a lot where there is a small chance that a lot will be accepted by the specified sampling plan.

NOTE 1: For use throughout this standard, the term LQ is established at the percent nonconforming having probability of lot acceptance equal to 10%.

NOTE 2: For precise computation of the LQ value for finite lots of discrete parts, it is generally the case that no integer number of nonconforming units produces exactly 10% probability of acceptance, so the LQ for that sample size can be computed as the weighted average of the two nearest points on the discrete OC curve [see Appendix C (C.2.2)].

3.32 Lot [also referred to as a Batch or Grouping]

A defined quantity of some product, material, or service collected and submitted together for acceptance.

NOTE: It is often expected that a lot be homogeneous in its manufacturing conditions. A lot for product acceptance purposes is not necessarily the same as a lot formed for purposes of a contract, shipment, or anything other than acceptance.

3.33 Lot-by-Lot Inspection

Inspection of each sequential lot in a series.

3.34 Lot Homogeneity

A quantity of product, material, or service that shows consistent characteristics throughout the quantity within a lot.

3.35 Lot Tolerance Percent Defective (LTPD)

The level of quality in a lot that the lot-sampling plan will accept 10% of the time [see 3.31, Limiting Quality (LQ)].

3.36 Material Review

The process of determining the disposition of nonconforming material.

3.37 Multi-Level Continuous Sampling Plan

A continuous sampling plan that changes frequency or amount of inspection by a set of rules, based upon the results of past plan inspections.

3.38 Must

A step that is inherent in meeting obligations from authorities outside this document, especially those of customers, regulatory authorities, or the laws of mathematics.

NOTE: The use of the term “must” in this document is distinct from the use of the term “shall”.

3.39 Nonconformance

Parts or materials that do not meet specifications or requirements. The failure of a characteristic to conform to the requirements specified in the contract, drawings, specifications, or other approved product description.

3.40 Nonconformity

A specific occurrence of a condition that does not conform to a specification or other inspection standard.

3.41 Nondestructive Testing (NDT) [also referred to as Nondestructive Inspection (NDI)]

Technique of testing material properties without impairing their future usefulness.

3.42 Normal Inspection

The default level of lot-by-lot inspection sampling plans with switching rules.

NOTE: Switching rules in sampling standards begin with this level of inspection, and direct the inspection to greater or lesser inspection according to the patterns of quality in the process.

3.43 One-Hundred Percent (100%) Inspection

Inspection of every item of product or service.

3.44 Operating Characteristic (OC) Curve

A curve on a graph for a given sampling plan showing the lot fraction defective (x-axis) versus the probability that the sampling plan will accept the lot (y-axis).

NOTE: This term is also applied to AOQ, Average Fraction Inspected (AFI), Average Total Inspected (ATI), and ARL curves.

3.45 Organization

The entity or party that is performing the work.

3.46 Outgoing Quality Confidence Limit (OQCL)

A computed confidence limit on the probability of conformance for delivered product after sampling.

NOTE: Computations depend on the lot size, sample size, acceptance criteria, screening policy, rectification policy, and Confidence Level (CL).

3.47 Poisson Distribution

A discrete frequency distribution that gives the probability of a number of independent events occurring in a fixed population, where the population can be an interval of time, volume, area, or length.

$$\Pr[X = x] = \frac{m^x}{x!} e^{-m} \quad (\text{Eq. 10})$$

where:

x = the number of occurrences (0, 1, 2, ...)

m = the population mean (m > 0)

e = the base of natural logarithms (2.71828...)

3.48 Probability Outgoing Quality Limit (POQL)

An upper confidence limit on the outgoing percent nonconforming in a finite series of lots.

NOTE: This is the maximum of the curve that represents the 90% upper confidence limit on the Outgoing Quality (OQ) and it depends on the sample size, acceptance criteria, the length of the series of lots, and any switching rules that apply.

3.49 Process

A combination of activities, methods, and resources, including people, material, machines, tools, and environment, that transform inputs into output products or services.

3.50 Process Control

The disciplines of controlling the variables of a process to ensure the resultant characteristic meets requirements.

NOTE: The adequacy of process controls is described in section 8.

3.51 Process Control Point

A step (in a process) at which a full or partial control is applied to prevent, eliminate, or reduce the risk of a nonconforming part continuing through the process.

3.52 Process Monitoring

Planned evaluations of the characteristic being accepted via process control to ensure that the process maintains stability.

3.53 Process Stability [also referred to as Stability]

A condition or state of behavior of a process where, through the use of past experience, limits of the process can be predicted for the near future. A condition where there is no indication of a special cause of variation, but where only random common cause variation is present.

3.54 Quality Parameter

A statistic of a product acceptance method that indicates the probability of conformance for each accepted unit of product to determine what it takes to ensure that the product conforms to its requirements (e.g., the IRR).

NOTE: Quality parameters include AOQL, OQCL, PPM, ERP, and Rejectable Quality Level (RQL).

3.55 Random Sample

A selection of units collected in such a manner that all units being accepted have an equal chance of being selected for inspection or evaluation.

3.56 Reduced Inspection

One of several levels of inspection connected by switching rules, which involves a lower fraction inspected than one or more of the others.

NOTE: In such a system the quality parameter is usually the AOQL and that AOQL is maintained, despite the lower fraction inspected, by the fact that the process generally only gets to that level when the quality is as good as or better than the AOQL for some period of time.

3.57 Rejectable Quality Level (RQL)

The minimum percent defective at which a lot will have 5% or less chance of being accepted when using a sampling plan.

NOTE: For precise computation of the RQL value for finite lots of discrete parts, it is generally the case that no integer number of nonconforming units produces exactly 5% probability of acceptance, so the RQL for that sample size can be computed as the weighted average of the two nearest points on the discrete OC curve [see Appendix C (C.2.2)].

3.58 Retrievability

The ability of a production system to identify or trace units, and make them available for appropriate disposition.

3.59 Sample

One or more units of product drawn from a lot, batch, or grouping to provide information.

3.60 Sampling Plan

A statement of sample size(s), frequencies, associated acceptance and rejection criteria, and switching rules (if applied).

3.61 Sequential Sampling

Sampling acceptance where a sequence of samples is taken from a lot or grouping and after each unit a decision is made to accept or reject the lot or grouping, or to continue sampling.

3.62 Shall

Indicates a requirement.

3.63 Should

Indicates a recommendation.

NOTE: If the organization chooses not to follow a “should” or other recommendation, then it is advisable to document the rationale for that decision.

3.64 Sigma

A Greek letter (σ) symbolizing standard deviation.

3.65 Single-Level Continuous Sampling

Alternating periods of 100% inspection and sampling inspection wherein the sampling rate is constant.

NOTE: The extent of periods of 100% inspection depends on the pattern of nonconformances.

3.66 Skip-Lot Inspection

Sampling inspection in which some lots in a series are accepted without inspection, when the sampling results for preceding lots from the same process meet stated criteria and all retrievability requirements for skipped lots have been met.

3.67 Standard Deviation

A measure of the spread or dispersion of the process output that has the same unit of measure as the original observations and the process mean (i.e., square root of the variance in a population). Usually identified by the Greek letter (σ) symbolizing standard deviation of the population.

3.68 Statistical Control

A process operating with a constant system of causes that result in a stable probability distribution of outcomes.

NOTE 1: Evidence of statistical control is provided by observations or observational statistics (e.g., average, range, standard deviation, maximum) appearing within limits calculated from extremes of the estimated stable distribution.

NOTE 2: Control charts depict graphically the observations and limits over time. Observational statistics within control limits are equivalent to failing to reject the null hypothesis that the process outputs come from a stable distribution.

NOTE 3: Tolerance limits do not enter into calculations of control limits or determination of statistical control.

NOTE 4: See Section 8 for more details and the method for determining when to accept a process as being adequately in statistical control.

3.69 Statistical Principles

A legitimate conclusion, based on samples taken from a defined population, claiming some probability value that is achieved by following a defined procedure; verifiable mathematics exists that shows this probability value is accurate. Refers to the phrase “justified on the basis of recognized statistical principles”, as used in quality management system standards.

3.70 Statistical Process Control (SPC)

A graphical/statistical method by which a process is monitored for patterns of variation.

NOTE: The resulting data is analyzed statistically to identify incidents of special causes of variation (see Section 8 for more details).

3.71 Statistically Valid

A legitimate conclusion, based on samples taken from a defined population, claiming some probability value that is achieved by following a defined procedure; by definition, verifiable mathematics exists that shows this probability value is accurate.

3.72 Subgroup

A segregation of process output such that it is reasonable to expect the same causal factors are present throughout the subgroup.

NOTE: A subgroup is represented on a control chart by a single point.

3.73 Supplier

The entity or party that supplies product or services to a customer in accordance with contractual requirements.

3.74 Switching Rules

Requirements used to adjust the level of inspection, such as between “Normal”, “Tightened”, and “Reduced” inspections.

3.75 Tightened Inspection

A level of sampling with switching rules that has more inspection than a “Normal” inspection level, but generally less than 100% inspection.

3.76 Unit

A single part or item.

NOTE: For continuous sampling application, this term can also apply to a lot with a small quantity of parts from a fixed process, where the sample size equals the lot size.

3.77 Variables Data [also referred to as Variables Measurement]

Quantitative measurements taken on a continuous scale.

4. GENERAL REQUIREMENTS

4.1 Introduction to General Requirements

The requirements of this section are common to the application of methods and techniques defined in Sections 6, 7, 8, and 9 which might be restated therein. Additional requirements specific to each method are defined in its respective section of the document. Refer to Figure 2 for guidance in determining which method and technique is appropriate for the product being assessed.

Regardless of the use of these statistical product acceptance methods, the organization shall be responsible to ensure that each part conforms to the engineering design requirements.

4.2 Trained Personnel

Personnel involved in the planning, application, and execution of statistical product acceptance do affect product quality and therefore shall be subject to the training requirements of the 9100/9110/9120 quality management system standards.

NOTE: Additional training requirements specific to process control are contained in 8.1.4.

4.3 Safety/Critical Characteristics

Any characteristics identified in the design documentation as “safety” or “critical” characteristics shall not be accepted using statistical product acceptance methods, unless prior written authorization is granted from the customer (e.g., a customer-approved procedure) such as when the method for acceptance is defined in the design documentation [see Appendix D (D.2) for guidance].

NOTE: Written authorizations for the use of statistical product acceptance on a “safety” or “critical” characteristic in accordance with the 9138 standard do not provide adequate information unless that authorization includes a quality parameter value.

4.4 Quality Requirements and Parameters

When the organization uses statistical techniques for product acceptance, they shall identify a quality parameter and value for each plan.

NOTE: This is an essential part of the 9138 standard fulfillment of the 9100 and 9120 requirement that “the sampling plan is justified on the basis of recognized statistical principles and appropriate for use.” The value of the quality parameter represents the risk level of sampling; when the risk level is acceptable for a statistical product acceptance plan, the “appropriate for use” stipulation is satisfied.

4.4.1 Quality Parameter

A statistical technique for product acceptance shall have a quality parameter that controls the probability of conformance of delivered product (see Appendix D for guidance).

When engineering specifications require an AQL, the consumer protection quality parameter shall be an AOQL.

NOTE: The column headings in many existing sampling tables are indexed by the AQL; however, the AQL is not a measure of protection for the customer. This standard requires the defining of a different quality parameter that provides protection for the customer. Along with other statistical acceptance requirements contained in this standard, the AQL figures must not be construed as allowing a nonconforming part to be delivered.

4.4.2 Quality Parameter Value

The quality parameter value shall be selected or approved by individuals who understand the consequences of nonconformance.

- a. The preferred method to identify the quality parameter value is for the design authority to specify an IRR via instructions on the purchase order, contract, engineering drawing, and/or related product definition documents. This IRR determines a maximum for the quality parameter value for the production logistics according to Appendix A.
- b. The quality parameter(s) chosen shall protect the customer by controlling the probability of conformance for delivered product.
- c. When instructions on the purchase order, contract, engineering drawing, and/or related product definition documents from the customer require a specific quality parameter and value, the statistical method shall provide at least that degree of protection.
- d. Quality can recommend alternative quality parameters or values to the customer authority using guidance in Appendix E (see E.3).
- e. If no other authority identifies an IRR value, then Appendix A (see Table A1) can be used as a default to demonstrate conventional levels of protection.
- f. When engineering specifications require an AQL, Table 1 shall be used to convert the AQL value to an AOQL value.

Table 1 - Acceptable Quality Level to Average Outgoing Quality Limit conversion

AQL	0.010%	0.015%	0.025%	0.040%	0.065%	0.100%	0.150%	0.25%
AOQL	0.018%	0.033%	0.046%	0.074%	0.113%	0.143%	0.198%	0.33%

AQL	0.40%	0.65%	1.00%	1.50%	2.50%	4.00%	6.50%	10.00%
AOQL	0.53%	0.79%	1.22%	1.90%	2.90%	4.94%	7.12%	11.46%

4.4.3 Alternative Quality Plans

The customer shall retain the right to approve alternative classification methods.

4.4.4 Regulatory Requirements

The organization shall be responsible for ensuring that any product acceptance methods comply with regulatory requirements.

4.5 Selection of Samples

Samples shall be representative of the unchecked production. Articles presented for acceptance by sample inspection shall share similar variability, quality level, and history as the unchecked production (see Appendix D for guidance).

Samples may be predetermined, if it has been determined by an ANOVA, Process Failure Modes and Effects Analysis (PFMEA), or other valid statistical analysis that the predetermined sample shall be over representative of nonconforming product.

4.6 Consideration of Product and Process Characteristics

The statistical product acceptance plan shall identify the product characteristics to be accepted under the plan. The organization shall create a statistical product acceptance plan that covers each applicable characteristic.

In addition to the general requirements of Sections 4 and 5, the plan shall meet the requirements of one of the supporting Sections 6, 7, 8, or 9. Refer to Figure 2 for guidance in determining which method and technique is appropriate for the product being assessed. See examples of these in Appendix F (see Table F1).

4.7 Evaluation Systems

Monitoring and measuring devices used to accept product shall be controlled as required by clause 7.6 in the 9100:2009 / 9110:2012 / 9120:2009 quality management system standards. When reliability values are specified in the design, measurement capability shall support those reliability requirements (see Appendices D, E, and F for guidance).

Statistical methods for product acceptance may be used in conjunction with NDT, unless disallowed by product engineering. If design drawings or specifications give instructions on destructive testing, those instructions take precedence over this standard.

4.8 Nonconformances (within the sample)

No discretion shall be permitted for measurements or conditions outside of the tolerances. Any deviations from design tolerance shall be reported as nonconforming and the affected production represented by the sample shall be controlled per the organization's quality instructions that govern nonconformances. In the event that any characteristic is rejected by the plan when lot or batch sampling is applied, the entire lot or batch shall be rejected and dispositioned in accordance with 9100-series standard requirements for nonconforming material.

NOTE: The primary options for disposition are to inspect the remaining product in the lot, scrap the product, or return the product to its source. A material review decision to accept the product as-is with no further inspection is not recommended due to the high probability that other uninspected units contain even more extreme nonconformances than the sample did (see Appendix D for guidance). This policy is known as "C=0".

When the sampling is continuous or skip-lot (see Section 9), or when the sampling uses reduced sampling levels that are less than would be required under isolated lot sampling (see Section 7), then the sampling plan shall accommodate adequate retrievability. Replacement or rectification of product is required. Production rates and frequencies of inspection shall be linked so that if nonconforming product is found, any product skipped since the previous inspection can be retrieved. Refer to the 9100:2009 / 9110:2012 / 9120:2009 quality management system standards (see clause 8.2.4) for instructions on monitoring and measuring of product.

4.9 Statistical Product Acceptance Plans and Records

The documentation of the sampling plan shall not provide for the acceptance of characteristics that are inadequately inspected in the samples. A sampling plan shall show the number of units of product from each lot or batch that are to be inspected and the criteria for determining the acceptability of the lot or batch. Both the statistical product acceptance plan and associated acceptance records shall show conformance to design requirements, account for all nonconformities in the sample, and shall be maintained in accordance with established procedures.

Plans for compiling and retrieving statistical acceptance information and acceptance data shall provide for adequate retrievability and shall provide for the verification that the plan is being executed correctly (see Appendix D for guidance).

4.10 Alternate Statistical Techniques for Product Acceptance

Alternate statistical techniques and unique applications intended for special cases are covered in Section 9. Techniques, other than those stated in this standard, that are developed and used shall be justified on the basis of recognized statistical principles to meet or exceed the required consumer protection quality parameter value or IRR (see 4.4 and 5.2). Reference Section 5 requirements for documenting these alternatives in written procedures and plans (see Appendix D for guidance).

4.11 Auditing of Statistical Techniques for Product Acceptance

Any statistical technique for product acceptance shall be reviewed as a part of periodic internal audits conducted in accordance with the 9100:2009 / 9110:2012 / 9120:2009 quality management system standards (see clause 8.2.2). A technical review of the statistical application should also be performed regularly. A technical review shall be conducted by individuals who understand the design of the statistical techniques used [see Appendix D (D.10) for guidance].

5. REQUIRED INFORMATION TO BE DOCUMENTED

5.1 Documented Procedure Requirements

The organization shall document their procedures, plans, and implementation activities of statistical product acceptance applications. The organization shall perform their planning and implementation of statistical product acceptance activities in accordance with those documented procedures and plans. At a minimum, these documents shall address the requirements of this section.

5.2 Initial Reliability Requirement or Quality Parameter Values for Product Acceptance

The documentation governing application of statistical techniques for product acceptance shall provide instruction on how to obtain specific IRR values for specific product characteristics (see Appendices A and E for guidance).

- a. Every assigned statistical technique for product acceptance, under the governing document, shall identify its quality parameter and the specific value that is achieved, as well as the basis for selecting that value (e.g., specification IRR). Every sampling plan or procedure shall show its quality parameter(s). Those quality parameter values shall be verifiable mathematically. If the statistical validity is claimed because the plan is copied from a published standard, then the specific standard shall be identified.
- b. Safety or critical characteristics shall be 100% inspected, except as directed by the design authority under the authorization of the customer.

5.3 Assigning Responsibilities

Procedures shall include assigned responsibility for administering statistical product acceptance plans (see Appendix D for guidance).

5.4 Assigning Where Applied

The organization shall define all current statistical techniques for product acceptance and the locations in the organization where they are applied (see Appendix D for guidance).

5.5 Establishing a Training Program

To assure effective implementation of statistical product acceptance applications, procedures shall require and define the training requirements of general and specific statistical requirements, methods, and intended audiences (see Appendix D for guidance).

5.6 Controlling Nonconformances

Procedures shall require methods for handling nonconforming product to assure that they do not escape and to provide for their prevention in the future. Procedures shall require that all discovered nonconformities be reported as nonconforming. Methods used to control nonconformances shall be defined or referenced in the established procedure.

5.7 Monitoring Performance and Effectiveness

Procedures shall define the processes used to ensure proper performance of statistical acceptance applications, including the use of any switching rules or changes to inspection frequency (see Appendix D for guidance). Procedures should also define the processes used to monitor other indications of inferior quality.

5.8 Defining Adjustments to Inspection Frequency

As applicable, procedures shall define any rationale used to adjust the level of inspection. The adjustment of inspection levels defined in the procedure shall be based on quality history.

5.9 Customer Approval of Procedures and Plans

When statistical acceptance procedures and plans are subject to approval by the customer prior to use, the organization's procedure shall document the process.

6. REQUIREMENTS FOR ACCEPTING PRODUCT BY INDIVIDUAL LOTS

6.1 General Requirements for Individual Lot Sampling

Applicable requirements defined in Sections 4 and 5 shall be followed when applying this section. This section provides additional requirements for accepting product by individual lots.

6.2 Quality Parameters for Individual Lot Sampling

Quality parameters that are based on the probability of conformance for delivered product are preferred; however, probability of acceptance parameters are acceptable if the probability of acceptance is 50% or less.

Implementing documentation shall specify which parameter is used as well as its value. The mathematics associated with the parameter shall be available either by reference or inclusion.

6.2.1 Delivered Product Conformance Probability Parameters

Probability of conformance for delivered product parameters are the AOQL, OQCL, or EOQ. The AOQL may be used when provisions are made to assure that all delivered units from a failed lot (one with one or more detected nonconformances) are confirmed to be conforming. Provisions can include screening operations and nonconformance scrapping or rectification. The OQCL should be used instead of the AOQL, if the entirety of a failed lot is simply scrapped. The EOQ may be used, if the distribution of the production process that produced the lot is known. See Appendix G (with emphasis on Figure G1) for further guidance on AOQL and OQCL, and Appendix H (see H.2.3) for EOQ guidance.

6.2.2 Probability of Acceptance Parameters

Acceptable parameters for lot sampling via probability of acceptance statistics are the RQL, the LQ, and the indifference point or ERP. These correspond respectively to nonconformance rates with probability of acceptance values on the probability of acceptance OC curve of 5% or less for the RQL, 10% or less for the LQ, and 50% or less for the ERP. See Appendix G (G.1.2) for further guidance.

6.3 Sample Sizes for Individual Lots

Tables of sample sizes for many individual sampling plans are found in the SCMH (<http://www.sae.org/scmh/>).

7. REQUIREMENTS FOR ACCEPTING PRODUCT PRODUCED UNDER SWITCHING RULES

7.1 General Requirements for Switching Rules

Applicable requirements defined in Sections 4 and 5 shall be followed when applying this section. This section provides additional requirements for accepting product produced under switching rules.

7.2 Background Information for Switching Rules

Switching rules are rules that change the sample size in response to the history of lot rejections and acceptances. Many applications have used three approaches for lot sampling:

- ANSI/ASQ Z1.4, which is equivalent to ISO 2859-1, JISZ9015-0 and JISZ9015-1, and GB/T 2828.1;
- ANSI/ASQ Z1.9, which is equivalent to ISO 3951-1, GB/T6378.1, or JISZ9003 with JISZ9004 and JIZ9010; and
- “Zero Acceptance Number Sampling Plans” (by N. L. Squeglia).

These have been used with switching rules and have a common characteristic of being organized around the AQL parameter. This section shows how to provide consumer protection under these conditions, which are challenging because of the AQL parameter being a measure of producer's risk. If the design engineering does not give an AQL, then the above documents and their switching rules do not apply; use other sampling strategies.

NOTE 1: If the user intends not to use switching rules, the requirements of Section 6 apply (see Appendix I for guidance).

NOTE 2: Where alternative statistical techniques are required for acceptance of product in attribute or variable lot acceptance sampling plans, other than those contained herein, those techniques are subject to the requirements of Section 9.

7.3 Quality Parameter with Switching Rules

Each sampling plan shall identify a parameter used to control consumer risk and identify the value of that parameter. If the AOQL parameter alone is applied, then the plan switching rules in the applicable standard shall be used. The key requirement for any sampling plan is the level of consumer protection provided; that is the level of assurance that an individual characteristic on outgoing product meets its design requirements (see Appendix G for guidance).

7.4 Requirements for Accepting Product with Switching Rules

7.4.1 Sampling Documentation

Sampling plans based on other procedures shall explicitly identify the documents on which they are based.

7.4.2 General Conditions

To achieve a required minimum probability of conformance (i.e., an IRR) the use of the tables in the subject standards referenced in the beginning of this section requires one of two approaches:

- a. different AQL columns in the standard can be used for different lot sizes in order to achieve the matching AOQL or ERP value; or
- b. an AQL column can be selected in which every AOQL or ERP entry satisfies the minimum probability of conformance.

See Appendix I (I.2) for examples of these approaches.