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AnAmerican National Standard

Standard Practice for Single- and Multi-Level Continuous Sampling of a Stream of Product by Attributes Indexed by AQL[1]

This standard is issued under the fixed designation E2819; 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 establishes tables and procedures for applying five different types of continuous sampling plans for inspection by attributes using MIL-STD-1235B as a basis for sampling a steady stream of lots indexed by AQL.

1.2 This practice provides the sampling plans of MIL-STD-1235B in ASTM format for use by ASTM committees and others. It recognizes the continuing usage of MIL-STD-1235B in industries supported by ASTM. Most of the original text in MIL-STD-1235B is preserved in Sections 6 – 10 of this practice.

1.3 *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 limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

E456 Terminology Relating to Quality and Statistics

E1994 Practice for Use of Process Oriented AOQL and LTPD Sampling Plans

E2234 Practice for Sampling a Stream of Product by Attributes Indexed by AQL

2.2 *Military Standards:*[3]

MIL-STD-1235A1 Functional Curves of the Continuous Sampling Plans

MIL-STD-1235B Single- and Multi-Level Continuous Sampling for Attributes

3. Terminology

3.1 *Definitions:*

3.1.1 For a more extensive list of terms in E11 standards see Terminology E456.

3.1.2 *acceptance quality limit (AQL), n*—quality limit that is the worst tolerable process average when a continuing series of lots is submitted for acceptance sampling. **E2234**

3.1.3 *average outgoing quality (AOQ), n*—the average percent defective of outgoing product including all accepted lots or batches after any defectives found in them are replaced by acceptable units, plus all lots or batches which are not accepted after such lots or batches have been effectively 100 % inspected and all defective units replaced by acceptable units. **E1994**

3.1.4 *average outgoing quality limit (AOQL), n*—the maximum AOQ for a given acceptance sampling plan for all possible incoming percentages defective for the process. **E1994**

3.1.5 *continuous sampling inspection, n*—a method of sampling a stream of product in order of production where the sampling frequency is adjusted based on ongoing inspection results.

3.1.5.1 *Discussion*—Only those units of product found by the inspector or screening crew to be nonconforming are rejected. The rest of production, uninspected units as well as units found to be conforming, is allowed to continue down the production line as conforming material.

3.1.6 *critical defect, n*—a defect that judgment and experience indicate would result in hazardous or unsafe conditions for individuals using, maintaining, or depending upon the product, or a defect that judgment and experience indicate is likely to prevent performance of the function of a major end item. **E2234**

3.1.7 *critical defective, n*—a unit of product which contains one or more critical defects and may also contain major and minor, or both, defects. **E2234**

3.1.8 *defect, n*—any nonconformance of the unit of product with specified requirements. **E2234**

3.1.9 *inspection, n*—the process of measuring, examining, testing, or otherwise comparing the unit of product with the requirements. **E2234**

[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.

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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] Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, http://dodssp.daps.dla.mil.

3.1.10 *inspection by attributes, n*—inspection whereby either the unit of product is classified simply as defective or non-defective, or the number of defects in the unit of product is counted, with respect to a given requirement or set of requirements. **E2234**

3.1.11 *major defect, n*—a defect, other than critical, that is likely to result in failure, or to reduce materially the usability of the unit of product for its intended purpose. **E2234**

3.1.12 *major defective, n*—a unit of product which contains one or more major defects, and may also contain minor defects but contains no critical defect. **E2234**

3.1.13 *minor defect, n*—a defect that is not likely to reduce materially the usability of the unit of product for its intended purpose, or is a departure from established standards having little bearing on the effective use or operation of the unit. **E2234**

3.1.14 *minor defective, n*—a unit of product which contains one or more minor defects but contains no critical or major defect. **E2234**

3.1.15 *process average (in inspection), n*—the average percent defective or average number of defects per hundred units (whichever is applicable) of product submitted by the supplier for original inspection. **E2234**

3.1.16 *unit of product, n*—that which is inspected in order to determine its classification as defective or non-defective or to count the number of defects. It may be a single article, a pair, a set, a length, an area, an operation, a volume, a component of an end product, or the end product itself. **E2234**

3.1.16.1 *Discussion*—The unit of product may or may not be the same as the unit of purchase, supply, production, or shipment.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *checking inspection, n*—sampling inspection performed by the supplier on units of product which have already been 100 % inspected in order to determine the effectiveness of the screening crew.

3.2.1.1 *Discussion*—This inspection is performed at the sampling rate *f* or more often.

3.2.2 *clearance number, n*—*i*, the number of consecutive conforming, that is, defect-free, units in 100 % inspection required prior to qualifying for inspection on a sampling basis.

3.2.3 *conforming unit, n*—a unit that meets the acceptance criteria established for the characteristic being considered.

3.2.4 *defects concerned, n*—defects being inspected for while using the sampling plan.

3.2.5 *inspection by defect class, n*—when one sampling plan is associated with inspection for several kinds of defects collectively and each unit of product inspected is inspected for each of the defects in the class.

3.2.6 *inspection by individual defect, n*—inspection where one sampling plan is associated with inspection for a single defect, or where a sampling plan is applied to each of several defects independently.

3.2.7 *moving product, n*—inspection where product is flowing past the inspection station.

3.2.7.1 *Discussion*—In the typical case the product moves on a conveyor belt or line; however, it may be moved in tote boxes, buggies or other conveyances which are operated manually or by mobile materials-handling equipment.

3.2.8 *multi-level, n*—plan consisting of periods of 100 % inspection and of sampling inspection at various rates which reflect past inspection results.

3.2.9 *one hundred percent (100 %) inspection, n*—the inspection of every unit of product for the defects concerned listed for an inspection station.

3.2.9.1 *Discussion*—The two terms, screening and 100 % inspection, are used interchangeably in this practice.

3.2.10 *production interval, n*—a finite period of production, N items in length.

3.2.10.1 *Discussion*—The production interval is normally a shift; it can be a day if it is reasonably certain that shift changes do not affect quality of product, but shall not be longer than a day.

3.2.11 *production interval length, n*—N, specified number of units to which CSP-F is to be applied.

3.2.12 *sampling frequency, n*—*f*, desired ratio between the number of units of product randomly selected and inspected at an inspection station and the number of unit passing the inspection station during periods of sampling inspection.

3.2.12.1 *Discussion*—In this practice, each *f* is expressed as a fraction of the form, 1/7, 1/25, 1/50, etc. The procedure used in selecting the sample units should give each unit of product presented during periods of sampling inspection an equal chance of being selected and inspected. Also referred to as "frequency of sampling".

3.2.13 *sampling inspection, n*—inspection for the defects concerned where the units selected for inspection are selected by sampling.

3.2.14 *screening, n*—100 % inspection where all defective units are removed from the production flow.

3.2.14.1 *Discussion*—The two terms, screening and 100 % inspection, are used interchangeably in this practice.

3.2.15 *single-level, n*—plan consisting of alternating periods of 100 % inspection and sampling inspection wherein the sampling rate is constant.

4. Significance and Use

4.1 The reason for preserving military sampling standards is that many organizations throughout the world still use these standards in their current form. MIL-STD-1235B is no longer supported by the U.S. Department of Defense as of the mid-1990s and is out of print, but does exist in the public domain. This practice represents a conversion of MIL-STD-1235B to an ASTM-supported standard.

4.2 This practice provides the tables and procedures for applying five different types of continuous sampling plans for inspection by attributes. These continuous sampling plans are discussed in Sections 6 – 10 of this practice and each section includes information on:

(a) Initiation of 100 % inspection in use.

(b) Requirements on when to switch to sampling inspection.

(c) Conditions warranting a return to 100 % inspection.

(d) When a change in Code Letter, if desired, can be made.

(e) What to do when the checking inspector finds a defect that was originally found conforming by the screening inspector(s), that is, ineffective screening.

(f) Situations where a defect is found before the switch to 100 % inspection causing excessive periods of 100 % inspection so action must be taken, that is, long periods of screening.

4.2.1 Section 6 (Section 2 in MIL-STD-1235B) describes specific procedures and applications of the CSP-1 sampling plans—a single-level continuous sampling procedure which provides for alternating between sequences of 100 % inspection and sampling inspection.

4.2.2 Section 7 (Section 3 in MIL-STD-1235B) describes specific procedures and applications of the CSP-F sampling plans—a variation of the CSP-1 plans in that CSP-F plans are applied to a relatively short run of product, thereby permitting smaller clearance numbers to be used.

4.2.3 Section 8 (Section 4 in MIL-STD-1235B) describes specific procedures and applications of the CSP-2 sampling plans—a modification of CSP-1 in that 100 % inspection resumes only after a prescribed number of defect-free units separate any two defective sample units.

4.2.4 Section 9 (Section 5 in MIL-STD-1235B) describes specific procedures and applications of the CSP-T sampling plans—a multi-level continuous sampling procedure which provides for reducing the sampling frequency upon demonstration of superior product quality.

4.2.5 Section 10 (Section 6 in MIL-STD-1235B) describes specific procedures and applications of the CSP-V sampling plans—a single-level continuous sampling procedure which is an alternative to CSP-T in that these plans provide for reducing the clearance number in good quality situations where reduction of sampling frequency has no economic merit.

5. General Description of Sampling Plans

5.1 This practice establishes continuous sampling plans and procedures for inspection by attributes. When this practice is referenced in a contract, specification, inspection standard or similar document, the provisions of this practice shall govern the application of all attributes type continuous sampling plans and procedures. Unless otherwise noted herein, the provisions of this practice shall be carried out by the supplier.

5.2 *Application*—The conditions that must exist before these sampling plans may be used are: *(a)* moving product, *(b)* ample space, equipment and manpower at or near the site of inspection to permit rapid 100 % inspection when required, *(c)* relatively easy and quick inspection, *(d)* a process which is producing, or is capable of producing, material whose quality is stable, and *(e)* the inspection is non-destructive. The sampling plans designated herein are applicable, but not limited, to inspection of various entities, viz., end items, components, raw materials, data or records, and any other entities, provided that the foregoing conditions are satisfied.

5.3 *Classification of Defects:*

5.3.1 *Method of Classifying Defects*—A classification of defects is the enumeration of possible defects of the unit of product classified according to their seriousness. Defects will normally be grouped into one or more of the following classes; however, defects may be grouped into other classes, or into subclasses within these classes.

5.3.1.1 *Critical Defect*—A critical defect is a defect that judgment and experience indicate is likely to result in hazardous or unsafe conditions for individuals using, maintaining, or depending upon the product; or a defect that judgment and experience indicate is likely to prevent performance of the tactical function of a major end item such as a ship, aircraft, tank, missile, or space vehicle. Note that for a special provision relating to critical defects, see 5.8.2.

5.3.1.2 *Major Defect*—A major defect is a defect other than critical that is likely to result in failure or materially reduce the usability of the unit of product for its intended purpose.

5.3.1.3 *Minor Defect*—A minor defect is a defect that is not likely to reduce materially the usability of the unit of product for its intended purpose, or is a departure from established standards having little bearing on the effective use or operation of the unit.

5.3.2 *Method of Classifying Defectives*—A defective is a unit of product which contains one or more defects. Defectives will usually be classified as follows:

5.3.2.1 *Critical Defective*—A critical defective contains one or more critical defects and may also contain major and minor, or both, defects. Note that for a special provision relating to critical defectives, see 5.7.2.

5.3.2.2 *Major Defective*—A major defective contains one or more major defects, and may also contain minor defects, but contains no critical defects.

5.3.2.3 *Minor Defective*—A minor defective contains one of more minor defects but contains no critical or major defects.

5.4 *Acceptable Quality Level (AQL):*

5.4.1 *Definition*—For continuous sampling plans, the AQL is an index to the plans, and has no other meaning.

5.4.2 *Use*—The AQL, together with the Sample Size Code Letter, is used for indexing the plans provided herein. The plans are also indexed by the Average Outgoing Quality Limit (AOQL).

5.4.3 *Limitation*—The designation of an AQL shall not imply that the supplier has the right to supply knowingly any defective unit of product.

5.4.4 *Specifying AQLs*—The AQL shall be designated in the contract or by the responsible authority. Different AQLs may be designated for groups of defects considered collectively, or for individual defects. An AQL for a group of defects may be designated in addition to AQLs for individual defects, or subgroups, within that group.

5.4.5 *Preferred AQLs*—The values of AQLs given in these tables are known as preferred AQLs. If, for any product, an AQL be designated other than a preferred AQL, these tables are not applicable.

5.5 *Average Outgoing Quality (AOQ):*

5.5.1 *Definitions:*

5.5.1.1 *AOQ*—The Average Outgoing Quality (AOQ) for a particular process average is the long run expected percentage

of defective material in the accepted material, if the associated sampling plan is followed faithfully (see 7.1 for classified meaning for CSP-F).

5.5.1.2 *AOQL*—The Average Outgoing Quality Limit (AOQL) is the maximum of all the possible values of AOQ if the associated sampling plan is followed faithfully (see 7.1 for classified meaning for CSP-F).

5.5.2 *Limitation*—The listing of values of AOQL in this practice does not imply that the supplier has a right to supply knowingly any defective unit of product.

5.6 *Submission of Product:*

5.6.1 *Lot or Batch*—Although lot or batch size is not used to select a continuous sampling plan, the formation of lots or batches may remain desirable for reasons of homogeneity, shipping convenience, and facilitation of payment.

5.6.2 *Order of Production*—All inspection should be performed in the order in which the units of product are produced, in order that the sources of quality problems can be more easily spotted and corrective action taken. In those situations where maintaining the order of production is not possible, for example, when production from two or more identical production lines is merged prior to inspection, the plans herein may still be used provided that the mixing of product from the lines is thorough, thereby assuring a random spacing of any defective units in the flow of product.

5.6.3 *Units of Product Submitted*—All units for which deposition is sought must pass each inspection station. This does not prevent process inspection by the supplier prior to arrival of the product at the inspection station, nor does this prohibit the supplier from removing or correcting units containing defects prior to submittal of the product. However, if, in the opinion of the consumer, the supplier's method of scheduling process inspection results in a flow of product during periods of screening inspection which is not representative of the flow of product which can be expected to be encountered during subsequent sampling inspection, the consumer reserves the right to cause the supplier to modify his method of scheduling process inspection.

5.7 *Acceptance and Rejection:*

5.7.1 *Responsibility*—Although both the consumer and supplier may reject nonconforming material of the supplier, only the consumer possesses the authority to accept (purchase) the supplier's material. However, since the supplier is responsible for providing material which satisfies contractual requirements, he will inspect the product through use of a sampling plan indexed by the designated AQL to determine whether or not to submit the product to the consumer.

5.7.2 *Special Reservation for Critical Defects*—The supplier may be required at the discretion of the responsible authority to inspect every unit for critical defects or to follow some other procedure with regard to the inspection of critical defects. If a critical defect is found on any unit of product, even if that unit has not been selected for inspection for critical defects, the supplier shall carry out the procedure specified by the consumer for critical defects.

5.7.3 *Disposition of Rejected Product*—Units found to be defective by either the supplier or consumer shall be removed and kept apart from the flow of product. The supplier may correct these units, in which case they will be screened and resubmitted to the consumer apart from the regular flow of product. If they are accepted by the consumer, they will be returned to the production line right after the inspection station for the defects concerned.

5.8 *Drawing of Samples:*

5.8.1 *Sample*—Under continuous sampling a sample consists of one unit or product drawn from the production line as it passes a given station.

5.8.2 *Frequency of Sampling*—Certain values of sampling frequency, *f*, are provided for each of the plans.

5.8.3 *Sample Selection*—The sample units shall be selected at the chosen sampling frequency (*f*) so as to give each unit of product an equal chance of being inspected. The inspector should allow the interval between sample units to vary somewhat rather than draw sample units according to a rigid pattern.

5.9 *Sampling Plans:*

5.9.1 *Definition*—As used herein, the phrase "sampling plan" denotes a particular procedure and the size(s) of the clearance number(s) and sampling frequency(ies) associated with it.

5.9.2 *Code Letters*—Sampling plans are designated by code letters. Table 1 provides permissible code letters based on the number of units in the production interval. A code letter and its associated sampling frequency should be selected after considering such influencing factors as inspection time per units of product, production rate, and proximity to other inspection stations. When idle inspector time is a significant consideration, a plan with higher sampling frequency and lower clearance number is usually preferred.

5.9.3 *Obtaining Sampling Plans*—The AQL and an appropriate code letter shall be used to obtain the sampling plan from Tables 2-A, 3-A, 4-A, 5-A, or 6-A. For CSP-F, it is also necessary to determine N (see 7.2.1).

5.9.4 *Types of Sampling Plans*—Five types of sampling plans: CSP-1, CSP-F, CSP-2, CSP-T, and CSP-V are provided in Tables 2-A, 3-A, 4-A, 5-A, or 6-A respectively. A selection of the appropriate plan can be made by a consideration of their individual features. CSP-1 is the simplest. CSP-F is a CSP-1 plan with clearance number adjusted to handle a shorter run of product. CSP-2 provides advance warning when a screening crew may have to be assembled. CSP-T provides for a reduction in sampling frequency in good quality situations. CSP-V provides for a reduction in clearance number in good quality situations, and is an alternative to CSP-T in those situations where a reduction in sampling frequency has no economic merit.

5.10 *Discontinuation of Inspection:*

5.10.1 *Long Periods of Screening*—When the use of 6.2.6, 7.2.6, 8.2.6, 9.2.6, and 10.2.6 give indication that an excessively long period of screening has been in progress, corrective action shall be taken to improve the production process and the consumer reserves the right to suspend product acceptance. The provisions of 6.2.6, 7.2.6, 8.2.6, 9.2.6, and 10.2.6 do not prevent the supplier from taking corrective action to improve the production process prior to reaching the limits described in the aforementioned paragraphs.

5.10.2 *Ineffective Screening*—If, during a period of 100 % inspection, a checking inspector finds a defect, the consumer shall be notified, and corrective action shall be taken to improve the effectiveness of the screening crew. If a second defect is found by the checking inspector during this period of 100 % inspection, the same action shall be taken by the supplier, and the consumer will reserve the right to suspend product acceptance. In the case of critical defects, the consumer reserves the right to suspend acceptance upon the finding of the first critical defect by the checking inspector during a period of 100 % inspection.

5.11 *Estimation of the Process Average:*

5.11.1 *Definition*—The process average (PA) is defined as the percent defective of product submitted by the supplier for original inspection. Original inspection is the first inspection of a particular quantity of product as distinguished from the inspection of product which has been previously submitted. The phrases "Process Average" and "Percent Defective of Submitted Product" are used interchangeably.

5.11.2 *Computation*—A reasonably good estimate of the process average can be made from the inspection results. If the inspection results used are for a set period of time or a pre-set number of units, the process average can be estimated as follows:

$$PA_{est} = \frac{100\,(\text{number of defectives observed})}{\text{number of units inspected}} \quad (1)$$

5.11.3 *Use*—The estimate of the process average, besides giving an indication of what percentage of manufactured product is defective, can also be used to consult the curves given in MIL-STD-1235A1.

6. CSP-1

6.1 *Features of CSP-1*—CSP-1 is a single-level continuous sampling procedure which provides for alternating sequences of 100 % inspection and sampling inspection with no limit as to the number of such sequences. CSP-1 requires a return to 100 % inspection whenever a nonconforming unit is discovered during sampling inspection. See Fig. A1.1 for a summary of the operation of CSP-1. Tables 2-A and 2-B list parameters associated with the procedure.

6.2 *Description of Procedure:*

6.2.1 *Initiation of Production*—At the start of production, each unit of product shall be inspected by the screening crew. Checking inspection shall be performed concurrently at a frequency *f* or more often on the units passed by the screening crew (see 6.2.5).

6.2.2 *Sampling Inspection*—Sampling inspection normally is initiated when the following requirements are satisfied:

6.2.2.1 All units of product are made according to the same drawing and specifications under stable conditions of production. This requirement, which is termed homogeneity, is usually satisfied when the production process is not altered by innovation, significant changes in materials, strikes, retooling (other than that due to routine changes to compensate for tool wear) or interruptions other than those due to the end of the shift, day, or week.

6.2.2.2 At least *i* consecutive units inspected by the screening crew during 100 % inspection are found free of the defects concerned.

6.2.2.3 None of the *i* consecutive units found defect-free by the screening crew are found defective by the checking inspector(s). When sampling inspection is begun, screening is terminated and samples are taken at the frequency, *f*.

6.2.3 *Return to 100 % Inspection*—Sampling inspection shall be terminated and 100 % inspection shall be resumed if either or both of the conditions described below occur. For critical defects, screening shall begin with the unit of product just after the last defect-free sample unit. (See 5.7.2 for further provisions for critical defects.)

6.2.3.1 The production process is interrupted for more than three operating days, or the requirement of 6.2.2.1 is otherwise not satisfied.

6.2.3.2 A unit having any of the defects concerned is found by the sampling inspector.

NOTE 1—When 100 % inspection is required, the flow of product is curtailed until the screening crew can begin 100 % inspection. 100 % inspection shall be continued until the requirements of 6.2.2 are met.

6.2.4 *Change in Code Letter*—If it is necessary or desirable to change Sampling Frequency Code Letters, the following applies:

6.2.4.1 If the change results in an increase in the sampling frequency, *f* (and, of course, a decrease in the clearance number, *i*), the change may be made at the next shift from a screening sequence to a sampling sequence or during a sampling sequence, whichever is the earlier.

6.2.4.2 If the change results in a decrease in the sampling frequency, *f* (and, of course, an increase in the clearance number, *i*), the change may be made at the next shift from a sampling sequence to a screening sequence or during a screening sequence, whichever is the earlier. (At any time the change may be made by initiating a screening sequence whose clearance number, *i*, will be that associated with the new code letter.)

6.2.5 *Ineffective Screening*—Whenever the checking inspector finds a defect in the product found conforming by the screening crew, the screening crew shall start a new count of consecutive defect-free units, and the actions described in 5.10.2 shall be carried out.

6.2.6 *Long Periods of Screening*—If, during a period of 100 % inspection, a defect is found before finding *i* consecutive conforming units and the number of units screened is equal to or greater than the appropriate value of *S* in Table 2-B, the supplier shall notify the consumer of this occurrence, and corrective action shall be taken to improve the production process. The consumer may, at its option, suspend acceptance immediately or at any time thereafter during the period of 100 % inspection until the supplier corrects the cause(s) of the high rate of defectiveness. After effective correction action has been taken, 100 % inspection shall be reinitiated.

7. CSP-F

7.1 *Features of CSP-F*—CSP-F is a single-level continuous sampling procedure which provides for alternating sequences

of 100 % inspection and sampling inspection. CSP-F is equivalent to the application of a CSP-1 plan to a specified number of units at a time, thereby permitting a smaller clearance number to be used. The plan may be applied in situations involving short production runs, or it may be applied to one or more production intervals at a time in situations involving time consuming inspection operations (for example, inspection with X-ray equipment) where a large clearance number could cause a production bottle-neck. See Fig. A1.2 for a summary of the operations of CSP-F. Table 3-A lists parameters associated with the procedure. AOQ and AOQL for CSP-F relate to the long run average and limit, respectively, over many periods of application of the plan, which in fact are the same as the expected values, respectively, for a single application of the plan.

7.2 *Description of Procedure:*

7.2.1 *Initiation of Period*—The period, in terms of number of units, N, for which the plan is to be applied, must first be determined, and plan parameters determined from Table 3-A. (If N is smaller than the value of *i* from Table 3-A, inspect all units.) At the start of production or of the period for which the plan is to be applied, each unit of product shall be inspected by the screening crew. Checking inspection shall be performed concurrently at a frequency *f* or more often on the units passed by the screening crew (see 7.2.5).

7.2.2 *Sampling Inspection*—Sampling inspection normally is initiated when the following requirements are satisfied:

7.2.2.1 All units of product are made according to the same drawings and specifications under stable conditions of production. This requirement, which is termed homogeneity, is usually satisfied when the production process is not altered by innovation, significant changes in materials, strikes, retooling (other than that due to routine changes to compensate for tool wear) or interruptions other than those due to the end of the shift, day, or week.

7.2.2.2 At least *i* consecutive units inspected by the screening crew during 100 % inspection are found free of the defects concerned.

7.2.2.3 None of the *i* consecutive units found defect-free by the screening crew are found defective by the checking inspector(s). When sampling inspection is begun, screening is terminated and samples are taken at the frequency, *f*.

7.2.3 *Return to 100 % Inspection*—Sampling inspection shall be terminated and 100 % inspection shall be resumed if any of the conditions described below occur. For critical defects, screening shall begin with the unit of product just after the last defect-free sample unit. (See 5.7.2 for further provisions for critical defects.)

7.2.3.1 The production process is interrupted for more than three operating days, or the requirement of 7.2.2.1 is otherwise not satisfied.

7.2.3.2 Any unit having any of the defects concerned is found by the sampling inspector.

7.2.3.3 The units to which the plan was intended to be applied have reached the point of inspection.

NOTE 2—The remaining units to be produced will be broken down into one or more groups, and the *i* value for each group will be determined from Table 3-A. For example, suppose that initially the size of a production run is to be 3,000 units, and subsequently it is determined that the run is to be 4,000 units. After 3,000 units have passed the point of inspection, 100 % inspection will be initiated, with an *i* value associated with N=1,000.

NOTE 3—When 100 % inspection is required, the flow of product is curtailed until the screening crew can begin 100 % inspection. 100 % inspection shall be continued until the requirements of 7.2.2 are met.

7.2.4 *Change in Code Letter*—If it is necessary or desirable to change Sampling Frequency Code Letters, the following applies:

7.2.4.1 If the change results in an increase in the sampling frequency, *f* (and, of course, a decrease in the clearance number, *i*), the change may be made at the next shift from a screening sequence to a sampling sequence or during a sampling sequence, whichever is the earlier.

7.2.4.2 If the change results in a decrease in the sampling frequency, *f* (and, of course, an increase in the clearance number, *i*), the change may be made at the next shift from a sampling sequence to a screening sequence or during a screening sequence, whichever is the earlier. (At any time the change may be made by initiating a screening sequence whose clearance number, *i*, will be that associated with the new code letter.)

7.2.5 *Ineffective Screening*—Whenever the checking inspector finds a defect in the product found conforming by the screening crew, the screening crew shall start a new count of consecutive defect-free units, and the actions described in 5.10.2 shall be carried out.

7.2.6 *Long Periods of Screening*—If, during a period of 100 % inspection, a defect is found before finding *i* consecutive conforming units and the number of units screened is equal to or greater than the appropriate value of *S* in Table 2-B (before N units have reached the point of inspection), the supplier shall notify the consumer of this occurrence, and corrective action shall be taken to improve the production process. The consumer may, at its option, suspend acceptance immediately or at any time thereafter during the period of 100 % inspection until the supplier corrects the cause(s) of the high rate of defectiveness. After effective corrective action has been taken, 100 % inspection shall be reinitiated.

NOTE 4—If several consecutive periods of some length N each have passed without going to sampling, and without reaching the *S* value because N is smaller than *S*, the consumer reserves the right to cause the supplier to use another sampling plan.

8. CSP-2

8.1 *Features of CSP-2*—CSP-2 is a type of single-level continuous sampling procedure which provides for alternating sequences of 100 % inspection and sampling inspection with no limits as to the number of such sequences. CSP-2 requires a return to 100 % inspection whenever two defective units are found separated by fewer than *i* consecutive sampled units but does not require return to 100 % inspection if *i* or more consecutive defect-free sample units separate two defective units. CSP-2 shall not be used for inspection for critical defects (see also 5.7.2). See Fig. A1.3 for a summary of the operation of CSP-2. Tables 4-A and 4-B list parameters associated with the procedure.

8.2 *Description of Procedure:*

8.2.1 *Initiation of Production*—At the start of production, each unit of product shall be inspected by the screening crew. Checking inspection shall be performed concurrently at a frequency *f* or more often on the units passed by the screening crew (see 8.2.5).

8.2.2 *Sampling Inspection*—Sampling inspection normally is initiated when the following requirements are satisfied:

8.2.2.1 All units of product are made according to the same drawings and specifications under stable conditions of production. This requirement, which is termed homogeneity, is usually satisfied when the production process is not altered by innovation, significant changes in materials, strikes, retooling (other than that due to routine changes to compensate for tool wear) or interruptions other than those due to the end of the shift, day, or week.

8.2.2.2 At least *i* consecutive units inspected by the screening crew during 100 % inspection are found free of the defects concerned.

8.2.2.3 None of the *i* consecutive units found defect-free by the screening crew are found defective by the checking inspector(s). When sampling inspection is begun, screening is terminated and samples are taken at the frequency, *f*.

8.2.3 *Return to 100 % Inspection*—Sampling inspection shall be terminated and 100 % inspection shall be resumed upon the occurrence of one or both of the conditions described below:

8.2.3.1 The production process is interrupted for more than three operating days, or the requirement of 8.2.2.1 is otherwise not satisfied.

8.2.3.2 Fewer than *i* consecutive defect-free sample units separate two defective sample units.

NOTE 5—When 100 % inspection is required, the flow of product is curtailed until the screening crew can begin 100 % inspection. 100 % inspection shall be continued until the requirements of 8.2.2 are met.

8.2.4 *Change in Code Letter*—If it is necessary or desirable to change Sampling Frequency Code Letters, the following applies:

8.2.4.1 If the change results in an increase in the sampling frequency, *f* (and, of course, a decrease in the clearance number, *i*), the change may be made at the next shift from a screening sequence to a sampling sequence or during a sampling sequence, whichever is the earlier.

8.2.4.2 If the change results in a decrease in the sampling frequency, *f* (and, of course, an increase in the clearance number, *i*), the change may be made at the next shift from a sampling sequence to a screening sequence or during a screening sequence, whichever is the earlier. (At any time the change may be made by initiating a screening sequence whose clearance number, *i*, will be that associated with the new code letter.)

8.2.5 *Ineffective Screening*—Whenever the checking inspector finds a defect in the product found conforming by the screening crew, the screening crew shall start a new count of consecutive defect-free units, and the actions described in 5.10.2 shall be carried out.

8.2.6 *Long Periods of Screening*—If, during a period of 100 % inspection, a defect is found before finding *i* consecutive conforming units and the number of units screened is equal to or greater than the appropriate value of *S* in Table 4-B, the supplier will notify the consumer of this occurrence, and corrective action shall be taken to improve the production process. The consumer may, at its option, suspend acceptance immediately or at any time thereafter during the period of 100 % acceptance until the supplier corrects the cause(s) of the high rate of defectives. After effective corrective action has been taken, 100 % inspection shall be reinitiated.

9. CSP-T

9.1 CSP-T is a multi-level continuous sampling procedure which provides for alternating sequences of 100 % inspection and sampling inspection. CSP-T requires a return to 100 % inspection whenever a nonconforming unit is discovered during sampling inspection, but provides for a reduced sampling frequency upon demonstration of superior product quality. CSP-T shall not be used for inspection for critical defects (see also 5.7.2). See Fig. A1.4 for a summary of the operation of CSP-T. Tables 5-A and 5-B list parameters associated with the procedure.

9.2 *Description of Procedure:*

9.2.1 *Initiation of Production*—At the start of production, each unit of product shall be inspected by the screening crew. Checking inspection shall be performed concurrently at frequency *f* or more often on the units passed by the screening crew (see 9.2.5).

9.2.2 *Sampling Inspection*—Sampling inspection normally is initiated when the following requirements are satisfied:

9.2.2.1 All units of product are made according to the same drawings and specifications under stable conditions of production. This requirement, which is termed homogeneity, is usually satisfied when the production process is not altered by innovation, significant changes in materials, strikes, retooling (other than that due to routine changes to compensate for tool wear) or interruptions other than those due to the end of the shift, day, or week.

9.2.2.2 At least *i* consecutive units inspected by the screening crew during 100 % inspection are found free of the defects concerned.

9.2.2.3 None of the *i* consecutive units found defect-free by the screening crew are found defective by the checking inspector(s). When sampling inspection is begun, screening is terminated and samples are taken at the frequency *f*. The sampling frequency may be reduced subject to the conditions shown on Fig. A1.4.

9.2.3 *Return to 100 % Inspection*—Sampling inspection shall be terminated and 100 % inspection shall be resumed if either or both of the conditions described below occur.

9.2.3.1 The production process is interrupted for more than three operating days, or the requirement of 9.2.2.1 is otherwise not satisfied.

9.2.3.2 A unit having any of the defects concerned is found by the sampling inspector.

NOTE 6—When 100 % inspection is required, the flow of product is curtailed until the screening crew can begin 100 % inspection. 100 % inspection shall be continued until the requirements of 9.2.2 are met.

9.2.4 *Change in Code Letter*—If it is necessary or desirable to change Sampling Frequency Code Letters, the following applies:

9.2.4.1 If the change results in an increase in the sampling frequency, *f* (and, of course, a decrease in the clearance number, *i*), the change may be made at the next shift from a screening sequence to a sampling sequence or during a sampling sequence, whichever is the earlier.

9.2.4.2 If the change results in a decrease in the sampling frequency, *f* (and, of course, an increase in the clearance number, *i*), the change may be made at the next shift from a sampling sequence to a screening sequence or during a screening sequence, whichever is the earlier. (At any time the change may be made by initiating a screening sequence whose clearance number, *i*, will be that associated with the new code letter.)

9.2.5 *Ineffective Screening*—Whenever the checking inspector finds a defect in the product found conforming by the screening crew, the screening crew shall start a new count of consecutive defect-free units, and the actions described in 5.10.2 shall be carried out.

9.2.6 *Long Periods of Screening*—If, during a period of 100 % inspection, a defect is found before finding *i* consecutive conforming units and the number of units screened is equal to or greater than the approximated value of *S* in Table 5-B, the suppler shall notify the consumer of this occurrence, and corrective action shall be taken to improve the production process. The consumer may, at its option, suspend acceptance immediately or at any time thereafter during the period of 100 % inspection until the supplier corrects the cause(s) of the high rate of defectives. After effective corrective action has been taken, 100 % inspection shall be reinitiated.

10. CSP-V

10.1 *Features of CSP-V*—CSP-V is a single-level continuous sampling procedure which provides for alternating sequences of 100 % inspection and sampling inspection. CSP-V requires a return to 100 % inspection whenever a nonconforming unit is discovered during sampling inspection, but provides for a reduced clearance number upon demonstration of superior product quality. It can be beneficially applied in those situations where there is no advantage to reducing sampling frequencies in the good quality situation; for example, when the inspector would merely have more idle time if the sampling frequency were reduced. CSP-V shall not be used for inspection for critical defects (see also 5.7.2). See Fig. A1.5 for a summary of the operation of CSP-V. Tables 6-A and 6-B list parameters associated with the procedure.

10.2 *Description of Procedure:*

10.2.1 *Initiation of Production*—At the start of production, each unit of product shall be inspected by the screening crew. Checking inspection shall be performed concurrently at a frequency *f* or more often on the units passed by the screening crew (see 10.2.5).

10.2.2 *Sampling Inspection*—Sampling inspection normally is initiated when the following requirements are satisfied:

10.2.2.1 All units of product are made according to the same drawings and specifications under stable conditions of production. This requirement, which is termed homogeneity, is usually satisfied when the production process is not altered by innovation, significant changes in materials, strikes, retooling (other than that due to routine changes to compensate for tool wear) or interruptions other than those due to the end of the shift, day, or week.

10.2.2.2 At least *i* (or *x* if appropriate) consecutive units inspected by the screening crew during 100 % inspection are found free of the defects concerned.

10.2.2.3 None of the *i* (or *x* if appropriate) consecutive units found defect-free by the screening crew are found defective by the checking inspector(s). When sampling inspection is begun, screening is terminated and samples are taken at the frequency, *f*.

10.2.3 *Return to 100 % Inspection*—Sampling inspection shall be terminated and 100 % inspection shall be resumed if either or both of the conditions described below occur. The appropriate clearance number will be determined according to the procedural rules shown in Fig. A1.5.

10.2.3.1 The production process is interrupted for more than three operating days, or the requirement of 10.2.2.1 is otherwise not satisfied.

10.2.3.2 A unit having any of the defects concerned is found by the sampling inspector.

NOTE 7—When 100 % inspection is required, the flow of product is curtailed until the screening crew can begin 100 % inspection. 100 % inspection shall be continued until the requirements of 10.2.2 are met.

10.2.4 *Change in Code Letter*—If it is necessary or desirable to change Sampling Frequency Code Letters, the following applies:

10.2.4.1 If the change results in an increase in the sampling frequency, *f* (and, of course, a decrease in the clearance number, *i*), the change may be made at the next shift from a screening sequence to a sampling sequence or during a sampling sequence, whichever is the earlier.

10.2.4.2 If the change results in a decrease in the sampling frequency, *f* (and, of course, an increase in the clearance number, *i*), the change may be made at the next shift from a sampling sequence to a screening sequence or during a screening sequence, whichever is the earlier. (At any time the change may be made by initiating a screening sequence whose clearance number, *i*, will be that associated with the new code letter.)

10.2.5 *Ineffective Screening*—Whenever the checking inspector finds a defect in the product found conforming by the screening crew, the screening crew shall start a new count of consecutive defect-free units, and the actions described in 5.10.2 shall be carried out.

10.2.6 *Long Periods of Screening*—If, during a period of 100 % inspection, a defect is found before finding *i* consecutive conforming units and the number of units screened is equal to or greater than the appropriate value of *S* in Table 6-B, the supplier shall notify the consumer of this occurrence, and corrective action shall be taken to improve the production process. The consumer may, at its option, suspend acceptance immediately or at any time thereafter during the period of 100 % inspection until the supplier corrects the cause(s) of the

high rate of defectives. After effective correction action has been taken, 100 % inspection shall be reinitiated.

11. Keywords

11.1 AOQ; AOQL; AQL; checking inspection; clearance number; continuous sampling plan; CSP-1; CSP-2; CSP-F; CSP-T; CSP-V; inspection by attributes; screening

ANNEX

(Mandatory Information)

A1. SAMPLING PLAN TABLES

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Table 2-A	Values of *i* for CSP-1 Plans
Table 2-B	Values of *S* for CSP-1 Plans
Values of *i* for CSP-F Plans	
Table 3-A-1	Values of *i* for CSP-F Plans (AQL=.010%, AOQL=.018%)
Table 3-A-2	Values of *i* for CSP-F Plans (AQL=.015%, AOQL=.033%)
Table 3-A-3	Values of *i* for CSP-F Plans (AQL=.025%, AOQL=.046%)
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Table 3-A-5	Values of *i* for CSP-F Plans (AQL=.065%, AOQL=.113%)
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Table 4-A	Values of *i* for CSP-2 Plans
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Table 5-A	Values of *i* for CSP-T Plans
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Figure A1.1	Procedure for CSP-1 Plans
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Figure A1.4	Procedure for CSP-T Plans
Figure A1.5	Procedure for CSP-V Plans

TABLE 1

SAMPLING FREQUENCY CODE LETTERS

Number of Units in Production Interval	Permissible Code Letters
2–8	A, B
9–25	A through C
26–90	A through D
91–500	A through E
501–1,200	A through F
1 201–3 200	A through G
3 201–10 000	A through H
10 001–35 000	A through I
35 001–150 000	A through J
150 001 and up	A through K

TABLE 2-A

Values of *i* for CSP-1 Plans

Sample Frequency Code Letter	*f*	AQL[A] in %															
		0.01	0.015	0.025	0.04	0.065	0.1	0.15	0.25	0.40	0.65	1.0	1.5	2.5	4.0	6.5	10.0
A	1/2	1540	840	600	375	245	194	140	84	53	36	23	15	10	6	5	3
B	1/3	2550	1390	1000	620	405	321	232	140	87	59	38	25	16	10	7	5
C	1/4	3340	1820	1310	810	530	420	303	182	113	76	49	32	21	13	9	6
D	1/5	3960	2160	1550	965	630	498	360	217	135	91	58	38	25	15	11	7
E	1/7	4950	2700	1940	1205	790	623	450	270	168	113	73	47	31	18	13	8
F	1/10	6050	3300	2370	1470	965	762	550	335	207	138	89	57	38	22	16	10
G	1/15	7390	4030	2890	1800	1180	930	672	410	255	170	108	70	46	27	19	12
H	1/25	9110	4970	3570	2215	1450	1147	828	500	315	210	134	86	57	33	23	14
I	1/50	11730	6400	4590	2855	1870	1477	1067	640	400	270	175	110	72	42	29	18
J	1/100	14320	7810	5600	3485	2305	1820	1302	790	500	330	215	135	89	52	36	22
K	1/200	17420	9500	6810	4235	2760	1178	1583	950	590	400	255	165	106	62	43	26
		0.018	0.033	0.046	0.074	0.113	0.143	0.198	0.33	0.53	0.79	1.22	1.90	2.90	4.94	7.12	11.46
								AOQL in %									

[A] AQLs are provided as indices to simplify use of this table, but have no other meaning relative to the plans.

TABLE 2-B

Values of *S* for CSP-1 Plans

Sample Frequency Code Letter	*f*	AQL[A] in %															
		0.01	0.015	0.025	0.04	0.065	0.1	0.15	0.25	0.40	0.65	1.0	1.5	2.5	4.0	6.5	10.0
A	1/2	1850	925	721	451	295	273	197	119	75	55	36	22	17	11	10	6
B	1/3	4080	1950	1600	993	649	579	442	268	166	120	78	52	36	24	19	16
C	1/4	6010	2915	2360	1460	1010	926	699	421	262	177	115	79	57	36	28	20
D	1/5	8320	3890	3100	1930	1390	1150	975	589	367	258	165	109	76	45	40	27
E	1/7	11400	5670	4660	2395	1980	1750	1355	813	807	376	244	154	109	63	54	34
F	1/10	16900	7590	6640	4120	2800	2595	1985	1245	624	543	352	221	164	90	82	51
G	1/15	24400	11300	9250	5760	4020	3820	2960	1810	922	856	524	327	241	141	138	75
H	1/25	35500	16900	13900	8640	5950	5740	4560	2760	1390	1350	839	524	390	212	189	105
I	1/50	59800	26900	23000	14300	10300	10100	8440	5070	3170	2445	1590	913	733	368	334	212
J	1/100	96000	39800	36400	23300	16900	16500	14300	8710	6020	3980	2600	1640	1360	642	601	382
K	1/200	148100	63700	58000	36000	29000	28800	25400	15200	9470	8030	4365	2835	2150	1080	1025	636
										0.53	0.79	1.22	1.90	2 J0	454	7.12	11.46
													AOQL in %				

[A] AQLs are provided as indices to simplify use of this table, but have no other meaning relative to the plans.