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Standard Practice for Writing Specifications for Textiles[1]

This standard is issued under the fixed designation D 3777; 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 covers general methods for specifying textile product characteristics that may be measured or counted.

1.2 There are many different types of acceptance samplings plans. This practice describes five types. (See 1.5.)

1.3 This practice describes general methods for writing the sampling plans of the types named in 1.5 whose characteristics may be measured or counted. The requirements are described in terms of what the basic unit is and what limit constitutes a nonconforming item. Tables are provided from which appropriate sampling plans can be designed. Numerical examples illustrate the design of sampling plans and the construction of their consequent operating characteristic curves.

1.4 *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.*

1.5 This practice includes the following sections:

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1.6 The annexes include:

Topic Title	Annex Number
Types of Sampling Plans:	
Single-Sample Fraction-Nonconforming Attribute Data	Annex A1
Single-Sample Nonconformances-per-Unit	Annex A2
Single-Sample by Variables to Control Fraction-Nonconforming with Standard Deviation Known	Annex A3
Single-Sample by Variables to Control Fraction-Nonconforming with Standard Deviation Unknown	Annex A4
Chain Sampling	Annex A5

2. Referenced Documents

2.1 *ASTM Standards:*

D 123 Terminology Relating to Textiles[2]

D 2906 Practice for Statements on Precision and Bias for Textiles[2]

D 4271 Practice for Writing Statements on Sampling in Test Methods for Textiles[3]

2.2 *Adjunct*

TEX-PAC[4]

NOTE 1—Tex-Pac is a group of PC programs on floppy disks, available through ASTM Headquarters, 100 Barr Harbor Drive, West Conshohocken, PA 19428, USA. The points on the operating characteristic (OC) curves described in the Annexes of this Standard can be calculated using programs in this adjunct.

2.3 *Other Standards:*

ANSI/ASQC Z1.4 Sampling Procedures and Tables for Inspection by Attributes[5]

MIL-STD-105D Sampling Procedures and Tables for Inspection by Attributes[6]

MIL-STD-414 Sampling Procedures and Tables for Inspection by Variables by Percent Defective[6]

Tables of the Binomial Probability Frequency Distribution (No. 6 Of the Applied Mathematics Series), National Institute of Standards and Technology (NIST)[7]

3. Terminology

3.1 *Definitions:*

3.1.1 *acceptable quality level, (AQL or p_1), n—in acceptance sampling*, the maximum fraction of nonconforming items

[1] This practice is under the jurisdiction of ASTM Committee D13 on Textiles and is the direct responsibility of Subcommittee D13.93 on Statistics.

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[2] *Annual Book of ASTM Standards*, Vol 07.01.

[3] *Annual Book of ASTM Standards*, Vol 07.02.

[4] PC programs on floppy disks are available through ASTM. For 3½ inch disk request PCN:12-429040-18, for a 5¼ inch disk request PCN:12-429041-18.

[5] American Society for Quality Control, 230 West Wells Street, Milwaukee, WI 53203.

[6] Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

[7] Available from National Institute of Standards and Technology, NIST, Gaithersburg, MD 20899.

at which the process average can be considered satisfactory; the process average at which the risk of rejection is called the producer's risk.

3.1.2 *acceptance number, (c), n—in acceptance sampling*, the maximum for the number of nonconforming items in a sample that allows the conclusion that the lot conforms to the specification.

3.1.3 *acceptance sampling, n*—sampling done to provide specimens for acceptance testing.

3.1.4 *acceptance testing, n*—testing done to decide if a material meets acceptance criteria.

3.1.5 *chain sampling, n—in acceptance sampling*, a sampling plan for which the decision to accept or reject a lot is based in part on the results of inspection of the lot and in part on the results of inspection of the immediately preceding lots.

3.1.6 *consumer's risk, (β), n—in acceptance sampling*, the probability of accepting a lot when the process average is at the limiting quality level.

3.1.7 *laboratory sample, n*—a portion of material taken to represent the lot sample, or the original material, and used in the laboratory as a source of test specimens.

3.1.8 *limiting quality level, (LQL or p_2), n—in acceptance sampling*, the fraction of nonconforming items at which the process average can be considered barely tolerable; the process average at which the risk of acceptance is called the consumer's risk. (Syn. *lot tolerance fraction nonconforming*.)

3.1.9 *lot, n—in acceptance sampling*, that part of a consignment or shipment consisting of material from one production lot.

3.1.10 *lot tolerance fraction nonconforming, n*—see *limiting quality level.*

3.1.11 *nonconforming, adj*—a description of a unit or a group of units that does not meet the unit or group tolerance.

3.1.12 *nonconformity, n*—an occurrence of failing to satisfy the requirements of the applicable specification; a condition that results in a nonconforming item.

3.1.13 *operating characteristic curve, OC-curve, n—in acceptance sampling*, the curve which has as its abscissa an hypothesized lot average, and which has as its ordinate the probability of accepting the lot, when the plan is used. (See also *type A operating characteristic curve* and *type B operating characteristic curve.*)

3.1.14 *producer's risk, (α), n*—the probability of rejecting a lot when the process average is at the acceptable quality level, the *AQL*.

3.1.15 *rejection number, n—in acceptance sampling*, the minimum number of nonconforming items in a sample that requires the conclusion that the lot does not conform to the specification.

3.1.16 *sample, n*—(*1*) a portion of a lot of material which is taken for testing or for record purposes; (*2*) a group of specimens used, or observations made, which provide information that can be used for making statistical inferences about the population(s) from which they were drawn.

3.1.17 *sampling unit, n*—an identifiable discrete unit or subunit of material that could be taken as part of a sample.

3.1.18 *single sampling, n—in acceptance sampling*, a sampling plan for which the decision to accept or reject a lot is based on a single sample.

3.1.19 *specification, n*—a precise statement of a set of requirements to be satisfied by a material, product, system, or service, that indicates the procedures for determining whether each of the requirements is satisfied.

3.1.20 *type A operating characteristic curve, n*—an operating characteristic curve which describes the operation of a sampling plan where the size of the lot being sampled is taken into consideration.

3.1.21 *type B operating characteristic curve, n*—an operating characteristic curve which describes the operation of a sampling plan where items are drawn at random from a theoretically infinite process.

3.1.22 For definitions of textile and statistical terms used in this practice refer to Terminology D 123.

4. Significance and Use

4.1 All purchase agreements should be based on a specification of the material to be purchased which is agreeable to both parties. The parties should have a common understanding of the quality of material described by the specification. This practice describes how to write such a specification.

4.2 All purchase agreements should contain a sampling plan to use to determine the disposition of lots of material. A specification is not complete without a sampling plan. This practice describes how to write sampling plans which, when used as part of a purchase agreement, will give the parties a common understanding of the quality of material described, the risks connected with the sampling and testing procedures, and the procedures to follow when a lot is rejected.

4.3 It should be clearly understood that no sampling plan, including 100 % inspection, can make certain that all accepted lots will have a certain quality. No matter what the quality level a vendor supplies, if the purchaser continues to receive shipments from the same vendor, a portion of the shipments will be accepted by the sampling plan. All a sampling plan can do is increase the probability of acceptance of good lots, and decrease the probability of acceptance of bad lots.

4.4 When inspection is inexpensive and not destructive, or when it is extremely important that all nonconforming items be detected, conformance to the specification may be determined by complete inspection of every item in the lot.

4.5 When neither of the situations described in 4.4 pertain, a sampling plan which involves less than 100 % inspection may be used. A plan should be chosen which will divide the cost of imperfect judgments caused by inspecting only a portion of the lot between producer and buyer. This practice describes some simple methods for preparing sampling plans. More complex sampling plans may be justified when the costs of inspection are high. Such plans may be found in Duncan,[8,9] MIL-STD-105D, and in MIL-STD-414. In any case, sampling

[8] Duncan, Acheson J., *Quality Control and Industrial Statistics*, Richard D. Irwin, Inc., Homewood, IL, 1974.

[9] Hahn, Gerald J., Schilling, Edward G., "An Introduction to the MIL-STD-105D Acceptance Sampling Scheme," *Standardization News*, American Society for Testing and Materials, September 1975, pp. 20–26.

plans can be compared using their operating characteristic curves and their costs.

4.6 The operating characteristic curves in this practice are of the type B. That is, that the lots being inspected are assumed to be infinitely large. This assumption is convenient, and no significant error is introduced, if the lot size is 1000 or more items, or if the sample size is no more than 10 % of the lot size. In other cases the consumer's risk will be somewhat overstated.

5. Organizational Form for Specifications

5.1 The important parts of a specification are: designation number, title, scope, reference documents, terminology, requirements, sampling plan, test methods, and operating characteristic curve. See Part B of *Form and Style for ASTM Standards*[10] for further information regarding parts and their order of presentation.

6. Introductory Sections of Specifications

6.1 Write the sections on title, scope, referenced documents, and terminology in accordance with *Form and Style for ASTM Standards*.[10]

7. Requirements Section of Specification

7.1 State the requirements for a laboratory sampling unit. Requirements may be expressed as attributes or as variables. Tolerances may be one-sided or two-sided. It is recommended that the sections specifying the requirements are preceded by a center heading reading *Requirements.*

7.2 Table 1 illustrates the requirements and acceptance criteria for an attribute and a variables plan. This table is based on the examples in Annex A1 and Annex A3.

7.3 Tabulate the key parameters, specifying the OC-curves of sampling plans in a table similar to Table 2. Table 2 is based on the examples of Annex A1 and Annex A3.

8. Sampling

8.1 Follow the directions of Practice D 4271 in describing how sampling is to be done.

9. Test Methods

9.1 Specify a test method for every property for which requirements are indicated. List the test methods for the properties in exactly the same order that they are listed in the sections and tables on requirements. It is recommended that the sections specifying the test methods to be used are preceded by a center heading reading *Test Methods*.

9.2 Specify a test method in one of two ways:

[10] Available from ASTM Headquarters.

TABLE 1 Requirements of Acceptance Criteria[A]

Requirement	Test Method	Lot Acceptance Criteria
No separation of components	D XXXX	accept if nonconforming units < 2 in sample of 36 units
Tenacity, min = 1200 mN/tex $\sigma' = 324$	D YYY	accept if $\bar{X} > 1779.9$ mN/tex, for sample of 22 items

[A] $\bar{X}$ = observed average.

TABLE 2 Basis for Acceptance Sampling Plan

Property	Fraction of Lot Out of Specification		Risk Factors	
	Acceptable Quality Level	Limiting Quality Level	Producer's	Consumer's
Component separation	0.01	0.11	0.05	0.10
Tenacity	0.015	0.07	0.04	0.075

9.2.1 Use the preferred option of stating that the property will be tested as directed in an existing test method which is listed in the section on referenced documents. If it is necessary to make minor changes in the test method, add a section on precision and bias as follows: "The precision and bias of this test method are not changed significantly by the minor changes specified above." (See Practice D 2906.)

9.2.2 If the less desirable option of writing a test method within the specification is used, the test method cannot be referenced in another specification. In addition, the test method must include sections on scope, significance and use, procedure, and precision and bias as required by Part A of *Form and Style for ASTM Standards*.[10] For practical purposes, this option is no easier than writing a separate test method and contains serious drawbacks.

9.3 If neither a measurement nor a count can be made on a unit of the sample, state in writing what is to be done and how conformance is to be decided. If appropriate, specify that physical samples of satisfactory and unsatisfactory materials are to be exchanged by the producer and the buyer.

9.4 In case of a dispute arising from differences in reported test results follow the procedure described in the applicable test method.

10. Sampling Plans

10.1 *Single-Sample Fraction-Nonconforming Attribute Data*—Attribute inspections are summarized in terms of fraction of units not conforming. Simple two-point plans are based on two selected points on the operating characteristic curve. Single-sample plans base the decision to accept or reject the lot being sampled on one sample only. The plans in this standard are based on the binomial frequency distribution. They do not take into account inspections made on prior lots from the same vendor. The calculation of such plans is described in Annex A1.

10.2 *Single-Sample Nonconformances-Per-Item*—A single-sample nonconformance-per-unit plan consists of one sample of size *n* and an acceptance number *c*. If the sample has a total number of instances of nonconformances less than or equal to *c*, accept the lot; otherwise reject it. The calculation of such plans is described in Annex A2.

10.2.1 For such plans, it is assumed that the number of nonconformances per unit are distributed in the form of a Poisson distribution with mean equal to μ'.

10.3 *Single-Sample by Variables to Control Fraction-nonconforming with Standard Deviation Known*—Variables inspections are based on the assumption that the normal distribution is a suitable model for the data. Simple two-point plans are based on two selected points on the operating characteristic curve. They do not take into account results of inspections made on prior lots from the same vendor. Single-sample plans base the decision to accept or reject the lot on the