ASTM

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Standard Practice for
Writing Statements on Sampling in Test Methods for Textiles[1]

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1. Scope

1.1 This practice serves as a guide for preparing statements on sampling in methods of test for textiles. Illustrative texts are included which, with suitable modification, can be used as starting points for writing statements on sampling for any of the usual forms in which textiles are shipped.

1.2 Since the primary purpose of ASTM test methods is to evaluate some characteristic of a material being transferred from a supplier to a purchaser, the procedures for sampling in this practice are directed to the acceptance testing of commercial shipments of a product. Test methods which are not recommended for use in acceptance testing of commercial shipments or which are only intended for ranking products for developmental purposes, may require modifications in the format of the appropriate illustrative text, such as the omission of any reference to lot samples.

1.3 ASTM standards are developed by a consensus process that considers the interests of producers, consumers, and the general public. Committee D-13, therefore, recommends giving preference to methods of selecting sampling plans, such as the two-point plans in the annexes in Practice D 3777, that require conscious consideration of both the producer's risk and the consumer's risk. The consumer's risk can be determined for the sampling plans in MIL-STD-105D and MIL-STD-414 but those military standards tend to focus attention on the producer's risk rather than on both the producer's and consumer's risks.

1.4 This practice makes no attempt to develop any theoretical basis for sampling. The theoretical basis for sampling is discussed in a number of standard statistical texts **(1-5)**[2] as well as in Practice E 105. Procedures for developing simple two-point single sampling plans for acceptance testing are given in Practice D 3777.

1.5 This standard includes the following sections:

2. Referenced Documents

2.1 *ASTM Standards:*
D 123 Terminology Relating to Textiles[3]
D 584 Test Method for Wool Content of Raw Wool—Laboratory Scale[3]
D 1060 Practice for Core Sampling Raw Wool in Packages for Determination of Percentage of Clean Fiber Present[3]
D 1234 Method for Sampling and Testing Staple Length of Grease Wool[3]
D 1441 Practice for Sampling Cotton Fibers for Testing[3]
D 2258 Practice for Sampling Yarn for Testing[3]
D 2525 Practice for Sampling Wool for Moisture[3]
D 2905 Practice for Statements on Number of Specimens for Textiles[3]
D 3333 Practice for Sampling Man-Made Staple Fibers, Sliver, or Tow for Testing[4]
D 3777 Practice for Writing Specifications for Textiles[4]
E 105 Practice for Probability Sampling of Materials[5]

2.2 *Military Standards:*
MIL-STD-105D Sampling Procedures and Tables for Inspection by Attributes[6]

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[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] The boldface numbers in parentheses refer to the list of references at the end of this practice.

[3] *Annual Book of ASTM Standards*, Vol 07.01.
[4] *Annual Book of ASTM Standards*, Vol 07.02.
[5] *Annual Book of ASTM Standards*, Vol 14.02.
[6] Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

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

3. Terminology

3.1 *acceptable quality level* (*AQL* or p_1), *n—in acceptance sampling*, the maximum fraction of nonconforming items at which the process average can be considered satisfactory; the process average at which the risk of rejection is called the producer's risk.

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

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

3.4 *acceptance testing, n*—testing performed to decide if a material meets acceptance criteria.

3.5 *attribute, n*—a specific characteristic of a thing. (See *attribute data*.)

3.6 *attribute data, n*—observed values or determinations which indicate the presence or absence of specific characteristics. (See also *variate*.)

3.6.1 *Discussion*—The alternate conditions reported for an attribute are frequently described by such pairs of terms as "success" and "failure", "good" and" bad", "pass" and "fail", "go" and "no-go", and "acceptable" and "unacceptable". A discrete variate is the result of the reduction of two or more attribute data to a count of the number of successes or the number of failures or both.

3.7 *bulk sample, n—in the sampling of bulk material*, one or more portions which (*1*) are taken from material that does not consist of separately identifiable units and (*2*) can be identified after sampling as separate or composited units. (Compare *discrete sample*.)

3.7.1 *Discussion*—Since bales of staple are separately identifiable units, sampling a shipment by taking specific bales from the shipment is an example of discrete sampling. Since the fiber within a bale is not composed of separately identifiable units, sampling fiber from a bale is an example of the sampling of a bulk material.

3.8 *characteristic, n*—a property of items in a sample or population which, when measured, counted, or otherwise observed, helps to distinguish between the items.

3.9 *consumer's risk, (*β*), n*—the probability of accepting a lot when the process average is at the limiting quality level or LQL.

3.10 *continuous variate, n*—a variate that is a measurement based on a scale that is assumed to be continuous.

3.11 *determination value, n*—the numerical quantity calculated by means of the test method equation from the measurement values obtained as directed in a test method. (*Syn. determination*; see also *observation*.)

3.12 *discrete sample, n*—one or more units taken from a material that consists of separately identifiable units. (Compare *bulk sample*.)

3.13 *discrete variate, n*—a variate that is a measurement based on a scale that has a limited or finite number of steps; such as a count, a rating scale, or a ratio of successes to total observations.

3.14 *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.

3.15 *laboratory sampling unit, n*—a portion of material taken to represent one of the lot sampling units or the original material and used in the laboratory as a source of test specimens.

3.16 *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.

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

3.18 *lot sample, n*—one or more shipping units taken at random to represent an acceptance sampling lot and used as a source of laboratory samples.

3.19 *lot sampling unit, n*—a portion of material taken to represent a lot and used as a source of laboratory sampling units or test specimens or both. (*Syn. primary sampling unit*.)

3.20 *nonconforming item, n*—an item that does not satisfy the requirements of the applicable specification.

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

3.22 *observation, n—(1)* the process of determining the presence or absence of attributes or making measurements of a variable, (*2*) a result of the process of determining the presence or absence of an attribute or making a measurement of a variable. (Compare *measurement value*, *determination value*, and *test result*.)

3.23 *parameter, n—in statistics*, an independent variable that describes a characteristic of a population or mathematical model.

3.24 *primary sampling unit, n*—the sampling unit containing all of the sources of variability which should be considered in acceptance testing; the sampling unit taken in first stage of selection in any procedure for sampling a lot or shipment.

3.24.1 *Discussion*—For textiles, the primary sampling units are generally taken as the shipping units making up a lot; such as bales of fiber, cases of yarn, rolls of fabric, or cartons of garments or other finished products. Adequate sampling for acceptance testing requires taking into account not only the variability between primary sampling units but also the variability between subunits within primary sampling units and between specimens from a single subunit in a primary sampling unit.

3.25 *process average, n—for the items produced*, the true and unknown level of (*1*) the fraction of nonconforming items or (*2*) a characteristic of the items as determined by a specific test method.

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

3.27 *production lot, n*—that part of one manufacturer's production made from the same nominal raw material under essentially the same conditions and designed to meet the same specifications.

3.28 *random sampling, n*—the process of selecting units for a sample of size *n* in such a manner that all combinations of *n* units under consideration have an equal or ascertainable chance of being selected as the sample. (*Syn.* simple random sampling and sampling at random.)

3.28.1 *Discussion*—See standard texts on statistics and quality control for the use of random numbers to achieve proper randomization. In addition to random number tables, some computer generated numbers are acceptable. Equal probabilities are not necessary for proper random sampling so long as the probability of selection is ascertainable.

3.29 *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 specification.

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

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

3.31.1 *Discussion*—Since there are two or more stages in most sampling schemes, the sampling units in each stage must be clearly identified to avoid confusion. The number of stages in sampling schemes is not limited, but may be as few or as many as required by the nature of the material being sampled. The illustrative texts in this practice frequently identify three stages of sampling: (*1*) taking primary sampling units from a lot of material as a lot sample, (*2*) taking laboratory samples from each of the primary sampling units in the lot sample, and (*3*) taking test specimens from each of the units in the laboratory sample. (See also *primary sampling unit; laboratory sample*; and *specimen.*)

3.32 *specimen, n*—a specific portion of a material or laboratory sample upon which a test is performed or which is taken for that purpose. (*Syn.* test specimen.)

3.33 *state of statistical control, n*—a condition in which a process, including a measurement process, is subject only to random variation.

3.34 *systematic sampling, n*—the process of selecting units in a sample in accordance with a specific order or location in time or space or both.

3.35 *test result, n*—a value obtained by applying a given test method, expressed either as a single observation or a specified combination of a number of observations.

3.35.1 *Discussion*—A test result is the value reported for a single subunit of the laboratory sample. For different test methods a test result might be (*1*) the value of a single observation (such as a measurement of a property, a count of defects, or a grading or rating) on a single specimen from a single subunit of the laboratory sample; (*2*) the average or some other function of the values for single observations on each of *n* specimens from a single subunit of the laboratory sample; or (*3*) a ratio of successes to total observations for *n* specimens from a single subunit of the laboratory sample.

3.36 *variable, n*—a quantity to which any of the values in a given set may be assigned. (See *parameter* and *variate*.)

3.36.1 *Discussion*—The term "variable" is sometimes used loosely as a synonym for "variate".

3.37 *variate, n*—a measured value that includes a random error of measurement, a variable with which a probability distribution is associated. (See also *variable* and *attribute data*.)

3.38 For definitions of other textile terms used in this practice, refer to Terminology D 123.

4. Uses and Significance

4.1 This practice provides advice on the preparation of statements on sampling in test methods for textiles. It should be used whenever a new test method is written or when an existing test method needs a revised statement on sampling.

4.2 The objective of sampling may vary with the purpose for which the test method is used. The objective of sampling for acceptance testing is to obtain material which will estimate without bias a property of the lot being evaluated and which allows making a decision on whether to accept or reject a lot with reasonable producer's and consumer's risks when the acceptable quality level and the limiting quality level are at realistic levels.

4.3 There are normally many ways to estimate the property of interest to a specified degree of precision. The most economical way to do so will depend on the relative size of the sources of variability associated with sampling and the relative cost of sampling the primary sampling units, subunits from within a primary sampling unit, and specimens from within a subunit of a primary sampling unit.

4.3.1 The sources of variability associated with the test method that are estimated by an interlaboratory testing program may be useful in writing statements on the precision of the test method but may not be useful in planning a sampling program. For planning effective sampling procedures, it is necessary to know the sources of variability associated with sampling material of the type that is to be submitted for testing. Estimating such sources of variability normally is done by a nested analysis of variance within the laboratory of the purchaser or supplier or both **(2)**.

4.4 When a test method is used in acceptance sampling, the information in the statement of sampling in the test method itself should be supplemented by more specific instructions either in a material specification or in an agreement between the purchaser and the supplier. See Practice D 3777.

4.5 Annex A1 gives an explanation and a schematic diagram of the nomenclature used in sampling and testing procedures.

5. General Considerations

5.1 *Attributes vs. Variates*—Avoid any tendency to require the use of attribute data when the use of variates may be a better choice. If there is a choice, use economics as the basis of a decision on whether the result of a test is to be reported as attribute data or as a variate. To achieve comparable powers of discrimination, decisions can usually be based on a smaller sample size when measuring a variate rather than observing an attribute. Generally, however, it costs more to measure a variate than to observe an attribute. Attribute data should be used only if the total cost of collecting and using the larger