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An American National Standard

Standard Practice for Sampling and Accepting a Single Lot of Paper, Paperboard, Fiberboard, and Related Product[1]

This standard is issued under the fixed designation D 585; 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.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope

1.1 This practice covers a procedure for obtaining a sample to represent a lot of paper or paperboard, fiberboard, or related product, including converted paper products (all hereafter referred to as *paper*).

1.2 Prior to purchase, there should be agreement between buyer and seller on the size of the lot to be sampled (5.1), on details of the sampling procedure, the required physical and chemical properties, dimensional tolerances, etc., and the test methods to be employed.

1.3 Appendix X1 and Appendix X2, which provide useful, statistical criteria for accepting individual lots of paper on the basis of the number of defective test units, can assist the buyer and the seller in selecting an agreed-upon sampling and acceptance procedure.

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.*

2. Referenced Documents

2.1 *ASTM Standards:*

D 528 Test Method for Machine Direction of Paper and Paperboard[2]

D 1968 Terminology Relating to Paper and Paper Products[2]

D 5039 Test Methods for Identification of Wire Side of Paper[2]

2.2 *ISO Standard:*

ISO 186 Paper and Board–Sampling for Testing[3]

2.3 *Military Standards:*

MIL-STD-105D Sampling Procedures and Tables for Inspection by Attributes[4]

MIL-STD-414 Sampling Procedure and Table for Inspection by Variables for Percent Defective[4]

3. Terminology

3.1 *Definitions*—Definitions shall be in accordance with Terminology D 1968 and the *Dictionary of Paper*.[5]

4. Significance and Use

4.1 If a lot of paper is to be accepted or rejected on the basis of a series of tests made on the paper, it is important to sample the paper in a way that will give a test result that is representative of the lot of paper.

5. Establishing the Lot

5.1 *General Considerations*—Avoid grouping together as a lot batches of paper likely to differ significantly from each other in raw materials or manufacture. If the shipment is small or consists of a large number of batches, it may be uneconomical or impracticable to form lots conforming with the definition (3.1). If this is the case, divide the shipment into portions, to be designated "sublots," in which each portion conforms to the definition of *lot*. Before starting the sampling, obtain a complete understanding of the paper to be sampled, including the composition and size of lots and sublots, rolls, skids, etc.

5.2 *Location of Sampling*:

5.2.1 *Sampling at the Paper Mill*—When paper is to be delivered in large rolls or skids, if agreed, have the sample taken at the paper mill and delivered to the purchaser for examination and testing. Include in the purchase agreement a definition of the number of rolls or skids constituting a lot and details of the sampling procedure to ensure compliance with the rules in selecting the sample in accordance with Section 6.

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[1] This practice is under the jurisdiction of ASTM Committee D06 on Paper and Paper Products and is the direct responsibility of Subcommittee D06.92 on Test Methods.

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[2] *Annual Book of ASTM Standards*, Vol 15.09.

[3] Available from American National Standards Institute, 11 W. 42nd St., 13th Floor, New York, NY 10036.

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

[5] Available from the Technical Association of the Pulp and Paper Industry, Technology Park, P.O. Box 105113, Atlanta, GA 30348.

Especially indicate whether the sample was taken from mill reels or from the finished rolls or skids.

5.2.2 *Sampling in Transit or Warehouse*—It may be necessary to take a sample at a dock or warehouse en route between the supplier and the purchaser, especially for international shipments or in referee sampling for testing. Sampling in transit or warehouse can be quite expensive and should be avoided whenever possible, because of the problem of resealing. Arranging to inspect the shipment prior to unloading is recommended on inspection in transit. Establish the size of each lot and determine which rolls or skids will be sampled, and arrange to sample and reseal the rolls or skids as they are loaded or unloaded to minimize additional handling. Obtain the sample in accordance with Section 6.

5.2.3 *Sampling After Receipt*—This type of sampling has the obvious disadvantage of delaying evaluation of the shipment and of providing the least favorable conditions for disposal of a rejected lot. Other considerations are the same as above for sampling in transit.

5.3 *Representativeness of the Sample*—The test units of the sample usually cannot be taken at random from anywhere within a large roll or skid, but must be taken near the outer layers so as not to destroy the roll or skid. If such test units are regularly taken at the paper mill (5.2.1) and a reasonably uniform quality of production is being maintained, then the test units will, in the long run, be quite representative of average production, even though not randomly selected and therefore not "representative" from a statistical viewpoint. Such test units, however, taken when the lot is in transit or warehouse (5.2.2) or after receipt (5.2.3), cannot be said with certainty to be representative of the shipment; for example, rolls shipped to a customer may have been selected because their outer layers met the customer's specification, with no knowledge as to whether properties vary from the outer layers to the core of the roll. Such test units therefore may be neither random nor "representative," but they are all that is available "to represent" the lot, which experience shows they do fairly well unless nonuniform manufacture or aging has occurred.

6. Selecting the Sample

6.1 Determine the area of paper required for each test unit (see 3.3) and the number of test units required. Take a sample consisting of the required number of test units in accordance with a predetermined procedure, designed to eliminate deliberate selection of any particular area of paper (see X1.5), and as far as practicable, conforming to the following rules:

6.1.1 *Rule 1: Take test units in proportion to the sizes of the sublots*—When a lot divides naturally into sublots consisting of discrete quantities such as carloads, pallet loads, rolls, etc., or when certain portions of the lot differ from one another and are segregated as "sublots" (5.1), take the test units in such a way that the number of test units taken from a given sublot is proportional to the size of the sublot.

6.1.2 *Rule 2: Take the test units so that each area of paper in the lot or sublot has an equal probability of being selected*—It is recognized that difficulties of handling may not permit the taking of test units from locations scattered throughout the lot, but this should be done to the greatest practicable extent.

6.1.3 *Rule 3: Take test units indiscriminately*—Take the units without regard to their condition or quality but do not sample the outermost sheets of a roll or skid. Also do not sample from inner sheets that have been damaged by handling, abrasion, etc., unless it is evident that similarly damaged areas occur throughout the lot.

6.2 *Compliance with Rules 2 and 3* may be assured in accordance with the following procedure: Divide the lot or sublot into "locations" (carloads, skids, cartons, etc.) in such a way that each location contains an equal quantity of paper. Assign a number to each location and select the locations to be sampled by drawing numbers at random from a hat or from a table or random numbers. Next assign and select the sublocations or areas within a location by the same procedure. In order to minimize handling during sampling, observe the precautions of Section 5.

6.2.1 When test units are to be taken from *small rolls, reams, bundles, cartons or shipping containers* of completed paper products, divide the lot or sublot into "locations," etc., and proceed as described above.

6.2.2 When test units are to be taken from *large rolls or skids*, divide the lot or sublot into "locations" and "sublocations" no smaller than a roll or unopenable skid (see 6.3.2), assign and select numbers as described above, then proceed as described in 6.3.

NOTE 1—In ISO and British Standards, the word *reel* is used for a continuous sheet or board wound on a core and the word *roll* for the same when wound without a core. In the United States, the distinction is between the "reel" at the end of the paper machine and the "rolls" (with or without the cores) made therefrom.

6.3 *Large Rolls or Skids*:

6.3.1 When taking a test unit from a *large roll* remove all damaged layers from the outside of the roll and, in addition, discard at least three undamaged layers for sheets having a nominal grammage of less than 250 g/m^2 or at least one undamaged layer for heavier sheets. Cut the roll across its full width and to a sufficient depth to enable the requisite number of sheets to be taken. Let the cut sheets fall to each side and remove the roll.

6.3.2 When taking a test unit from a *skid or roll that may not be opened* at the time of sampling, cut a window 300 by 450 mm or larger if larger test specimens are required. Cut the window with its longer side in the machine direction when this is known, or if not known, mark "Direction Unknown" or determine the machine direction using Test Method D 528 and mark whether the machine direction is the short dimension or long dimension. For paper that has been sheeted simultaneously from several rolls, take a sufficient number of adjacent sheets to assure representation of all the rolls used. Cut the sheets to sufficient depth to enable the requisite number of sheets to be taken and remove them. Remove all outside sheets that are damaged and, in addition, discard at least the three outermost undamaged sheets for paper having a nominal grammage less than 250 g/m^2 or at least one outmost undamaged sheet of heavier paper. Vary the position of the window at random among the skids or rolls from which test units are to be drawn, making sure that the sides of the window are parallel to those of the skid or to the roll edge and axis.

6.3.3 In either of the above, if a test for *moisture content* is to be made, it may be necessary to discard considerably more than three undamaged sheets of paper and one undamaged sheet of board. In one case reported in the literature,[6] it was necessary to discard 40 sheets of manila board to obtain the moisture content of the major portion of the roll.

7. Care of Samples

7.1 Keep the test units smooth and flat, except for transporting, when it may be better to ship the test unit in a tube. Protect the sample from exposure to direct sunlight, moisture of the hands, contact with liquids or other harmful influences such as extremes of temperature or humidities above 58 % relative humidity. Consult the product specification and the test methods for directions as to any precautions to be taken or special handling necessary.

8. Cutting and Marking

8.1 Trim test units with their edges parallel to the machine and cross directions. Avoid watermarks or creases for other than grammage determinations; also avoid any unusual flaws or blemishes that might subsequently affect the test results. Mark test units for identification, for example, the locations from which they were taken, and, if needed, their machine direction (see Test Method D 528) and top side (see Test Methods D 5039).

9. Sampling Report

9.1 When required, give a brief description of the shipment or lot and the sampling including:

9.1.1 Type and grade of paper or paperboard with a reference to the specification, if available.

9.1.2 Form in which purchased (that is, dimensions of rolls or sheets; packaging; etc., if not covered in the product specification).

9.1.3 Total quantity (usually weight or area), or purchase order number, or both.

9.1.4 Lot number or other identification of specific lot sampled (if divided into sublots, identification or description of sublots).

9.1.5 Date of sampling.

9.1.6 Location of sampling (mill, warehouse, in transit, etc.).

9.1.7 Description and enumeration of any portions of the shipment excluded from sampling because of damage.

9.1.8 Deviations from the specified sampling procedure if it was found to be not reasonably possible to follow the prescribed directions.

9.1.9 Authority requesting the sample (if appropriate).

10. Keywords

10.1 fiberboard; paper; paperboard; sampling

[6] Yezek, M., "Some Aspects of Moisture Measurement in Paper and Paperboard," *TAPPI* 41 (8): 193A (1958).

APPENDIXES

(Nonmandatory Information)

X1. Useful Acceptance Plans

X1.1 *Individual Lot Acceptance*—The appropriate sampling-acceptance plan provided in Appendix X2 is to be used only for individual lot acceptance when no other plan has been specified and this method has been referenced. A plan that is tailored to the specific paper product, grade, type of defects, and use, etc., is preferable to a general plan. However, the general plans provided in Appendix X2 are considered to be a good compromise between the costs of testing and the risks of wrong decisions, and are applicable to a wide range of paper products.

X1.2 The acceptance plans given in Appendix X2 are called "attribute" acceptance plans because a test unit fails if it fails to conform to one or more of the requirements for which it is tested and acceptance of the lot is based on an acceptably low number of units failing.

X1.3 ISO 186 uses an engineered sampling plan to determine the lot average, with 5 % of the shipping units sampled but with a minimum of 5 and a maximum of 20.

X1.4 Maltenfort and Boedecker[7] describe a "variables" acceptance plan in which acceptance is based on the average of the values obtained for the test units and the variability among these values.

X1.5 Deliberate nonrepresentative or semirepresentative selection of rolls or skids for sampling may be desirable to emphasize expected stock problems. The plan uses the bills of lading to select skids or rolls at the beginning and near the end of the run, then randomly through the run but stressing front and back positions. These are the areas from which production problems may be expected to arise. This approach is nonrandom, not statistical, but may be more economical when extremes and not averages are sought.

X1.6 When a continuing series of lots is being obtained from the same manufacturer, other plans (such as, MIL-STD

[7] Maltenfort, G. G., and Boedeker, R. E., "Sampling of Paper and Paper Products," *Industrial Quality Control* 14(11): 19(1958).

105D and MIL-STD 414) are likely to be more efficient as they can provide for increasing or reducing inspection as experience with that manufacturer indicates.

X2. Attribute Plans for Single-Lot Acceptance

X2.1 *Assumptions:*

X2.1.1 Since a lot is presumed to be reasonably homogeneous (3.1), the plans presented below assume homogeneity and therefore provide only for acceptance or rejection of the lot as a whole. If the lot is not homogeneous, a test on one test unit of the sample might be so far off specification as to make at least the corresponding part of the lot unacceptable even though the proportion of off-specification test units would be so small as to indicate the whole lot should be accepted. Provision should be made for this situation in advance, for example, by calling for rejection of the lot as a whole because of its excess nonhomogeneity or by requiring complete screening (that is, testing of each part and rejecting substandard parts) if nonhomogeneity is found.

X2.1.2 The plans are based also on the assumption that the properties of a test unit drawn from the outer layers or sheets (6.3) or at random (in 6.2.1) are identical with the properties throughout the roll, skid, ream, carton, etc., from which the test unit was taken. While this assumption is obviously not true, if the lot or sublot is reasonably uniform and the rules for selecting the sample are carefully followed, the acceptance plans will generally provide a satisfactory level of protection.

X2.2 *Application of Plans:*

X2.2.1 *Plan I*—For individual lots composed of large rolls that cannot be unwound or skids (pallets) that cannot be opened at the time of sampling (6.3.2).

X2.2.2 *Plan II*—For individual lots composed of small rolls (as tapes, toweling), reams, bundles, cartons, or shipping containers from which test units may be selected at random.

X2.2.3 *Plan III*—For" noncritical" chemical tests for individual lots composed as in X2.3.1 or X2.3.2.

NOTE X2.1—As used herein, *noncritical* means tests for which variability within the lot is of little or no significance and therefore the amount of testing called for by Plan I or II could not be justified.

X2.3 *Acceptance Definitions:*

X2.3.1 *Lot Size*:

X2.3.1.1 *Plan I*—The lot size (*N*) is the number of rolls or skids of which the lot (3.1) is composed.

X2.3.1.2 *Plan II*—The lot size (*N*) is the number of small rolls, reams, bundles, cartons, or shipping containers of which the lot is composed, as appropriate for the test to be made. When a choice is possible (as in testing a property of the paper in a roll when an equal number of rolls are packed in each carton), select the unit (roll or carton) on which lot size is based so that the lot size will be greater than 25.

X2.3.1.3 *Plan III*—As for Plan I or II, as appropriate.

X2.3.2 *Sample Size*— The number of test units (3.3) of which the sample (3.2) for test is composed, determined from lot size in accordance with Table X2.1, Table X2.2, or Table X2.3.

TABLE X2.1 Plan I for Large Rolls or Skids

Lot Size, *N*	Sample Size		Acceptance and Rejection Numbers			
	n	n_t[A]	*Ac*	Re	Ac_t[B]	Re_t[B]
1	1		0	1		
2	2		0	1		
3 to 5	3		0	1		
6 to 10	4		0	1		
11 to 100	5		0	1		
101 to 300	8	16	0	2	1	2
301 to 1200	13	26	0	3	2	3
1201 and over	20	40	0	3	3	4

[A] n_t = total sample size, that is, sum of test units in first and second part, of double sample.
[B] Ac_t and Re_t = acceptance and rejection numbers for double sample.

TABLE X2.2 Plan II for Small Rolls, Reams, Bundles, Etc.

Lot Size, *N*	Sample Size		Acceptance and Rejection Numbers			
	n	n_t[A]	*Ac*	Re	Ac_t[B]	Re_t[B]
2 to 25	2		0	1		
26 to 150	3		0	1		
151 to 1 200	5		0	1		
1 201 to 35 000	8	16	0	2	1	2
35 001 and over	13	26	0	3	2	3

[A] n_t = total sample size, that is, sum of test units in first and second part, of double sample.
[B] Ac_t and Re_t = acceptance and rejection numbers for double sample.

TABLE X2.3 Plan III for Noncritical Chemical Tests

Lot Size, *N*	Sample Size, *n'*	Acceptance and Rejection Numbers	
		Ac	Re
2 to 100	2	0	1
101 to 1 200	3	0	1
1 201 to 35 000	4	0	1
35 001 and over	5	0	1

X2.3.3 *Acceptance*— A lot is either accepted or rejected as a whole on the basis of tests carried out on the sample. Each test unit of the sample is separately evaluated.

X2.3.4 *Defective Test Unit*—A test unit that fails to conform to one or more of the requirements for which it has been tested.

X2.3.5 *Acceptance Number*—A number used in connection with a sampling plan (Table X2.1, Table X2.2, or Table X2.3), such that if the number of defective test units in the sample is less than or equal to this number, the lot should be passed for the properties tested.

X2.3.6 *Rejection Number*—A number used in connection with a sampling plan (Table X2.1, Table X2.2, or Table X2.3), such that if the number of defective test units in the sample is greater than or equal to this number, the lot should be rejected.

X2.4 *Level of Protection*—If the above assumptions are true, the plans provide the following:

X2.4.1 *Protection to Producer*—The lot will be accepted with a probability of at least 95 % if the proportion of the defective items contained in it does not exceed 2.5 %.

X2.4.2 *Protection to Consumer*—The lot will be rejected with a probability of at least 90 % if the proportion of the defective items contained in it reaches 16 to 32 % in Plan I, 19 to 68 % in Plan II, and 37 to 68 % in Plan III, the smaller figure in each case applying to the largest lot size.

X2.5 *Instructions for The Use of Table X2.1, Table X2.2, and Table X2.3.*

X2.5.1 Select Table X1 or Table X2 according to the composition of the lot (X2.3.1 and X2.3.2).

X2.5.2 Locate the lot size (X2.4.1) in the first column of the selected table. The sampling and acceptance criteria to be used are those given on the line corresponding to this lot size.

X2.5.3 Take a first sample consisting of the number of test units equal to the number in the column headed *n*. Sample according to the rules for selecting a sample to represent a lot (6.1), including in each test unit enough additional material for noncritical chemical tests (X2.5.10-X2.5.13).

X2.5.4 Subject each of the *n* test units of this sample to the appropriate number of test determinations for each of the required test properties. For noncritical chemical tests follow instructions in X2.5.10-X2.5.13.

X2.5.5 Record the number of defective units thus found.

X2.5.6 *First Sample Criteria*:

X2.5.6.1 If the number from X2.5.5 does not exceed the number in column *Ac*, the lot should be considered to meet the requirements relating to the properties tested.

X2.5.6.2 If the above number equals or exceeds the number in column *Re*, the lot should be considered as having failed to meet the requirements of the detail specification.

X2.5.6.3 If the above number exceeds the acceptance number (*Ac*) but is less than the rejection number (*Re*), proceed to the next step.

X2.5.7 Take a second sample equal in size to the first so that the total number of test units in the first and second sample is n_t. Again take this sample in accordance with the rules for selecting a sample to represent a lot.

X2.5.8 Follow X2.5.4 and X2.5.5, and compute the total number of defective test units in the two samples.

X2.5.9 *Total Sample Criteria*:

X2.5.9.1 If the number in X2.5.8 does not exceed the number in Ac_t, the lot is considered to meet the requirements relating to the properties tested.

X2.5.9.2 If the above number equals or exceeds the number in column Re_t, the lot shall be considered as having failed to meet the requirements of the detail specification.

X2.5.10 If the lot satisfies X2.5.6.1 or X2.5.9.1 and noncritical chemical tests are specified, determine the sample size (n') for these tests in accordance with Table X3 .

X2.5.11 Select the above n' test units at random from the *n* test units obtained in accordance with 5.3.

X2.5.12 Subject each of the n' test units of this sample to all the required noncritical chemical tests, and record the number of defective test units thus found.

X2.5.13 *Chemical Test Criteria*:

X2.5.13.1 If the number of defective test units (X2.5.12) is zero, the lot is considered to meet the requirements relating to noncritical chemical tests.

X2.5.13.2 If the number is greater than zero, the lot shall be considered as having failed to meet the requirements of the detail specification.

X2.6 *Acceptance Report*—Report lot size, sample size, number of defective test units found, and the nature of the defects.