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Standard Test Method for Attribute Sampling of Metallic and Inorganic Coatings¹

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1. Scope

1.1 This test method gives sampling plans that are intended for use in the inspection of metallic and inorganic coatings for conformance to ASTM standard specifications.

1.2 The plans in this test method, except as noted, have been selected from some of the single sampling plans of MIL-STD-105D. The specific plans selected are identified in Tables 1-3 of this test method. The plan of Table 4, which is used for destructive testing, is not from the Military Standard. This standard does not contain the Military Standard's requirement for tightened inspection when the quality history of a supplier is unsatisfactory.

1.3 The plans are based on inspection by attributes, that is, an article of product is inspected and is classified as either conforming to a requirement placed on it, or as nonconforming. Sampling plans based on inspection by variables are given in Method B 762. Variables plans are applicable when a test yields a numerical value for a characteristic, when the specification imposes a numerical limit on the characteristic, and when certain statistical criteria are met. These are explained in Method B 762.

1.4 The plans in this test method are intended to be generally suitable. There may be instances in which tighter or looser plans or onesthat are more discriminating are desired. Additional plans that may serve these needs are given in Guide B 697. Also, Guide B 697 describes the nature of attribute sampling plans and the several factors that must be considered in the selection of a sampling plan. More information and an even greater selection of plans are given in MIL-STD-105D, MIL-STD-414, ANSI/ASQC Z1.9, Refs (1-7)², and in Guide B 697.

1.5 *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 This test method is under the jurisdiction of ASTM Committee B-8 on Metallic and Inorganic Coatings and is the direct responsibility of Subcommittee B08.10 on General Test Methods.

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² The boldface numbers in parentheses refer to the list of references at the end of this Standard.

2. Referenced Documents

2.1 ASTM Standards:

B 697 Guide for Selection of Sampling Plans for Inspection of Electrodeposited Metallic and Inorganic Coatings³

B 762 Method of Variables Sampling of Metallic and Inorganic Coatings³

2.2 Military Standards:

MIL-STD-105D Sampling Procedures and Tables for Inspection by Attributes⁴

MIL-STD-414 Sampling Procedures and Tables for Inspection by Variables for Percent Defective⁴

2.3 ANSI Standard:

ANSI/ASQC Z1.9-1979 Sampling Procedures and Tables for Inspection by Variables for Percent Non-Conformance⁵

3. Terminology

3.1 Definitions:

3.1.1 *destructive test*—a test that destroys the tested article or makes it nonconforming to a requirement.

3.1.2 *inspection lot*—a collection of articles of the same kind that is submitted to inspection for acceptance or rejection as a group.

3.1.3 *nondestructive test*—a test that neither destroys the tested article nor makes it nonconforming to a requirement.

3.1.4 *sample*—articles randomly selected from an inspection lot whose quality is used to decide whether or not the inspection lot is of acceptable quality.

4. Significance and Use

4.1 Sampling inspection permits the estimation of the overall quality of a group of product articles through the inspection of a relatively small number of product items drawn from the group.

4.2 The selection of a sampling plan provides purchasers and sellers a means of identifying the minimum quality levels that are considered to be satisfactory.

³ *Annual Book of ASTM Standards*, Vol 02.05.

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

⁵ Available from American National Standards Institute, 11 W. 42nd St., 13th Floor, New York, NY 10036.

TABLE 1 Level I—Sampling Plan for Nondestructive Tests^A

Inspection Lot Size	Sample Size	Acceptance Number	AQL, %	50/50 Point, %	LQL, %	AOQL,%
1 to 20 ^B	all	0	...	...	...	...
21 to 280	20	0	0.26	3.4	11.0	1.8
281 to 1 200	80	1	0.44	2.1	4.8	1.1
1 201 to 3 200	125	2	0.65	2.1	4.3	1.1
3 201 to 10 000	200	3	0.68	1.8	3.3	0.97
10 001 to 35 000	315	5	0.83	1.8	2.9	1.0
Over 35 000	500	7	0.80	1.5	2.4	0.90

^A Taken from MIL-STD-105D, Single Sampling Plan, Level II, AQL = 0.65, Normal Inspection.

^B The smallest lots are 100 % inspected, and so there is no sampling risk. For this reason, there are no AQL, etc.

TABLE 2 Level II—Sampling Plan for Nondestructive Tests^A

Inspection Lot Size	Sample Size	Acceptance Number	AQL, %	50/50 Point, %	LQL, %	AOQL,%
1 to 8 ^B	all	0	...	...	...	...
9 to 90	8	0	0.64	8.3	25	4.6
91 to 280	32	1	1.1	5.2	12	2.6
281 to 500	50	2	1.7	5.3	10	2.7
501 to 1 200	80	3	1.7	4.6	8.2	2.4
1 201 to 3 200	125	5	2.1	4.5	7.4	2.5
3 201 to 10 000	200	7	2.0	3.9	5.9	2.2
10 001 to 35 000	315	10	2.0	3.4	4.9	2.1
Over 35 000	500	14	1.9	2.9	4.0	1.9

^A Taken from MIL-STD-105D, Single Sampling Plan, Level II, AQL = 1.5, Normal Inspection.

^B The smallest lots are 100 % inspected, and so there is no sampling risk. For this reason, there are no AQL, etc.

TABLE 3 Level III— Sampling Plan for Nondestructive Tests^A

Inspection Lot Size	Sample Size	Acceptance Number	AQL, %	50/50 Point, %	LQL, %	AOQL,%
1 to 5 ^B	all	0	...	...	...	...
6 to 50	5	0	1.0	12.9	37	7.4
51 to 150	20	1	1.8	8.2	18	4.2
151 to 280	32	2	2.6	8.2	16	4.3
281 to 500	50	3	2.8	7.3	13	3.9
501 to 1 200	80	5	3.3	7.1	11	4.0
1 201 to 3 200	125	7	3.2	6.1	9.4	3.6
3 201 to 16 000	200	10	3.1	7.3	7.7	3.3
16 001 to 35 000	315	14	2.9	4.7	6.4	3.0
Over 35 000	500	21	3.0	4.3	5.6	2.9

^A Taken from MIL-STD-105D, Single Sampling Plan, Level II, AQL = 2.5, Normal Inspection.

^B The smallest lots are 100 % inspected, and so there is no sampling risk. For this reason, there are no AQL, etc.

TABLE 4 Sampling Plan for Destructive Test^A

Inspection Lot Size	Sample Size	Acceptance Number	AQL,%	50/50 Point, %	LQL,%
1 to 25	2	0	2.5	29	68
26 to 1 200	13	1	2.8	13	27
1201 to 35 000	32	2	2.6	8.3	16
Over 35 000	55	3	2.5	6.6	12

^A AOQLs are not given because destructive tests cannot be used to screen rejected lots. This plan is not found in MIL-STD-105D.

4.3 Because sampling plans will only yield estimates of the quality of a product, the results of the inspection are subject to error. Through the use of sampling plans, the risk of error is known and controlled.

5. General

5.1 In sampling inspection, a relatively small number of articles (the sample) is selected randomly from a larger number of articles (the inspection lot) and is inspected for conformance to the requirements placed on the articles. Based on the results, a decision is made either to accept or reject the inspection lot.

Sampling is used, rather than inspection of every article in a lot, to reduce cost. Also, some test methods are destructive, in which cases sampling inspection must be used to avoid destroying the lot.

5.2 There is always a risk that a sample will not be representative of the lot from which it is drawn. The larger the sample, the smaller this risk, but, the larger the cost of inspection. So the selection of a sampling plan involves the balancing of the costs of inspection against the consequences of accepting an undesirable number of nonconforming articles. If every article in an inspection lot conforms to its requirements, every article in the sample will conform also. Such lots will always be accepted. If only a few articles in an inspection lot are nonconforming, the chances are that the sample will indicate that the lot is acceptable; but there is a small chance that the sample will indicate that the lot is unacceptable. The larger the proportion of nonconforming articles in an inspection lot, the more likely it will be that the sample will indicate that the lot is unacceptable. In the extreme case of every article in an inspection lot being nonconforming, a sample will always indicate that the lot is unacceptable.

5.3 For a given sampling plan, the chance of accepting an inspection lot that contains nonconforming items is often described in terms of the Acceptance Quality Level (AQL) and the Limiting Quality Level (LQL). The AQL is the quality level that is considered to be acceptable. The LQL is the quality level that is considered to be barely tolerable. A sampling plan is selected that will accept most submitted inspection lots of AQL quality and reject most lots of LQL quality. In this test method the AQL given for a sampling plan is the quality level of lots (expressed as the percentage of nonconforming articles) that have a 95 % chance of being accepted. The LQL is the quality level of lots that have a 10 % chance of being accepted or, in other words, a 90 % chance of being rejected. Also given with each sampling plan in this test method, is the quality level of an inspection lot that has a 50 % chance of being accepted. This is called the 50/50 point.

5.4 If all of the articles in a rejected inspection lot are inspected, and if nonconforming articles are removed and replaced with conforming articles, and then if the now 100 % conforming lot is resubmitted, the average quality level for a series of lots taken as a whole will be better because of the addition of the 100 % conforming lot. When the incoming lots are of a good quality level, the average quality level of a series of lots will be even better when the rejected lots are screened and resubmitted. When incoming lots are of a poor quality level, the average quality of a series of lots will again be good because many of the incoming lots will be rejected and upgraded. At intermediate quality levels of incoming lots, the average quality level of a series of lots will not be as good as in either of the above cases. The poorest average quality level that can result from the use of a given sampling plan when screening of rejected lots is done is called the Average Outgoing Quality Limit (AOQL). If corrective action is taken by the supplier so that there is a low rejection rate of initially supplied lots, the average quality level will be better than the AOQL (Note 1). This 100 % inspection of rejected lots cannot, of course, be used if the inspection test method is destructive. Screening of rejected lots will substantially increase the cost of inspection if the incoming lots are much worse than AQL quality. Screening is to be used only when required by the purchaser.

NOTE 1—The AOQLs given for Tables 1-3 are strictly correct only when the sample is small with respect to the lot. If the sample is consistently a significant part of the lot, the correct AOQL will be smaller than the tabulated value. The correct values are obtained by multiplying the tabulated values by:

$$1 - \text{sample size/lot size}$$

5.5 This test method contains four sampling plans. Three are intended to be used when the inspection methods are nondestructive. One of these (Table 2) is considered to be standard and is the one that is followed unless the user of this method specifies either a higher quality level (Table 1) or a lower one (Table 3). The fourth plan is intended to be used when the inspection methods are destructive. This last plan utilizes smaller samples and so reduces the cost of inspection but with a sacrifice in the ability to distinguish between acceptable and unacceptable lots.

6. Ordering Information

6.1 Unless otherwise specified by the purchaser, the sampling plan given in Table 2 will be used for nondestructive testing, and the plan given in Table 4 for destructive testing.

6.2 When either a nondestructive or a destructive test can be used to inspect an article for conformance to a particular requirement, the purchaser should specify which test is to be used. When a test is neither clearly nondestructive nor destructive (see Note 2, 8.3), the purchaser should specify which it is considered to be.

7. Formation of Inspection Lot

7.1 An inspection lot shall be formed from articles that are of the same kind, that have been produced to the same specification, and that have been coated by a single supplier at one time or at approximately the same time under essentially identical conditions.

8. Sampling

8.1 *General*—A sample shall be selected from the inspection lot. If the test method to be used is nondestructive, the sample size shall be that directed in 8.2. If the test method is destructive, the sample size shall be that directed in 8.3.

8.2 *Nondestructive Tests*—For nondestructive testing, the size of the sample shall be that specified for the sampling plan level that is required by the purchaser. The sampling plans are given for Level I in Table 1, for Level II in Table 2, and for Level III in Table 3. If the purchaser does not specify the level, Level II shall be used.

8.3 *Destructive Tests*—For destructive testing, the size of the sample shall be that specified in Table 4.

NOTE 2—The nature of a destructive test can be such that the tested article can be reclaimed, for example by stripping and reapplying the coating. Other tests can destroy the coating in nonessential locations, in which case the item can still be functional. In these instances the purchaser needs to decide and state whether the tests are to be considered destructive or nondestructive.

NOTE 3—The plan given for destructive tests uses smaller samples than the plans given for nondestructive tests. There may be cases in which destruction of even these smaller quantities is undesirable. For example, the articles may be expensive or the inspection lot may be small. Often in such cases test specimens are coated along with the articles and are used to represent them in the destructive tests. The permission to use test specimens and the requirements covering them and their use should be set forth in the applicable coating specification, purchase order, or other governing document.

8.4 The sample shall be drawn from the inspection lot randomly, that is, in a manner that assures each article an equal chance of being selected regardless of other considerations such as its location in the inspection lot, its appearance, its quality, its location on a fixture during coating, and its chronological relationship to the other articles. Random sampling procedures are given in the Annex of this test method.

9. Inspection and Lot Disposition

9.1 Each article in the sample shall be inspected as directed in the applicable coating standard. If the number of articles that do not conform to a particular requirement is equal to or less