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Standard Guide for Selection of Sampling Plans for Inspection of Electrodeposited Metallic and Inorganic Coatings[1]

This standard is issued under the fixed designation B697; 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 guide gives guidance in the selection of sampling plans to be used in the inspection of electrodeposited and related coatings on products for the purpose of deciding whether submitted lots of coated products comply with the specifications applicable to the coatings. This supplements Test Method B602 by giving more information on sampling inspection and by providing additional sampling plans for the user who finds the limited choice of plans in Test Method B602 to be inadequate.

1.2 When using a sampling plan, a relatively small part of the articles in an inspection lot is selected and inspected. Based on the results, a decision is made that the inspection lot either does or does not satisfactorily conform to the specification.

1.3 This guide also contains several sampling plans. The plans are attribute plans, that is, in the application of the plans each inspected article is classified as either conforming or nonconforming to each of the coating requirements. The number of nonconforming articles is compared to a maximum allowable number. The plans are simple and relatively few. Additional plans and more complex plans that cover more situations are given in the Refs (**1-7**) at the end of this guide and in MIL-STD-105.

1.4 Acceptance sampling plans are used:

1.4.1 When the cost of inspection is high and the consequences of accepting a nonconforming article are not serious.

1.4.2 When 100 % inspection is fatiguing and boring and, therefore, likely to result in errors. In these cases a sampling plan may provide greater protection than 100 % inspection.

1.4.3 When inspection requires a destructive test. Here, sampling inspection must be used.

1.5 Another general type of acceptance sampling plan that is not covered in these guidelines is the variables plan in which measured values of characteristics are analyzed by statistical procedures. Such plans, when applicable, can reduce inspection cost and increase quality protection. Information on variables plans is given in Test Method B762, MIL-STD-414, ANSI/ASQC Z1.9-1979, and Refs (**1-2**).

2. Referenced Documents

2.1 *ASTM Standards:*[2]

B602 Test Method for Attribute Sampling of Metallic and Inorganic Coatings

B762 Test Method of Variables Sampling of Metallic and Inorganic Coatings

2.2 *ANSI Standard:*[3]

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

2.3 *Military Standards:*[4]

MIL-STD-105 Sampling Procedures and Tables for Inspection by Attributes

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

3. General

3.1 *Procedure*—The use of acceptance sampling consists of a series of decisions and actions. These are listed in order below and are discussed in this standard.

3.1.1 Select characteristics to be inspected,

3.1.2 Select type of sampling plan,

3.1.3 Select quality level,

3.1.4 Define inspection lot,

3.1.5 Select sample,

3.1.6 Inspect sample,

3.1.7 Classify inspection lot, and

3.1.8 Dispose of inspection lot.

3.2 The need for acceptance sampling arises when a decision must be made about what to do with a quantity of articles.

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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 American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

[4] Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098.

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This quantity (called the inspection lot in this guide) may be a shipment from a supplier, may be articles that are ready for a subsequent manufacturing operation, or may be articles ready for shipment to a customer.

3.3 When acceptance sampling is done, several of the articles in the inspection lot are selected at random (see Section 7). These articles constitute the sample. Each article in the sample is inspected for conformance to the requirements placed on it. If an article meets a requirement, it is classified as conforming. If not, it is classified as nonconforming. If the number of nonconforming articles in the sample is no more than a predetermined number (called the acceptance number), the inspection lot is accepted. If it exceeds the acceptance number, the inspection lot is rejected.

3.4 The disposition of rejected inspection lots is beyond the scope of this guide because, depending on the circumstances, lots may be returned to the supplier, kept and used, put to a different use, scrapped, reworked, or dealt with in some other way. An exception is rectifying inspection (3.11) in which rejected lots are screened and used.

3.5 Because the decision about the disposition of an inspection lot is based on the inspection of a sample, and because there is a chance that a sample will not be representative of an inspection lot, some inspection lots that have the desired quality level (Note 1) will be rejected and some inspection lots that do not have the desired quality level will be accepted. There are only two situations in which the results of acceptance sampling are totally predictable (Note 2). One is when there are no nonconforming articles in the inspection lot. There, of course, will be no nonconforming articles in the sample and the decision to accept the lot will always be made. The other situation is when no article in the inspection lot conforms. All of the articles in the sample will be nonconforming and the decision to reject the lot will always be made (Note 3).

NOTE 1—In this guide the term "quality level" means the percentage of nonconforming articles in an inspection lot or it means the average percentage of nonconforming articles in a series of inspection lots received from a single source. Terms such as high quality, increased quality, and better quality mean a relatively smaller percentage of nonconforming articles, while terms such as low quality, decreased quality, and poorer quality mean a relatively larger percentage of nonconforming articles.

NOTE 2—In this discussion and elsewhere in this guide, it is assumed that no errors are made.

NOTE 3—To be strictly correct, lots that contain no more nonconforming articles than the acceptance number will always be accepted, and lots that contain fewer conforming articles than the sample size minus the acceptance number will always be rejected.

3.6 The discussion in 3.5 leads to two important points: (*1*) acceptance sampling plans will permit the acceptance of inspection lots that contain nonconforming articles, and (*2*) in a series of inspection lots, each containing the same percentage of nonconforming articles, some will be accepted and some will be rejected, and the percentage of nonconforming articles in the accepted inspection lots will be the same as in the rejected lots. In other words, acceptance sampling does not, by itself, result in higher quality. Rectifying inspection (3.11) will result in higher average quality in the product leaving inspection.

3.7 Because acceptance sampling plans permit the acceptance of inspection lots that contain nonconforming articles, basic to the selection of a sampling plan is a decision about the percentage of nonconforming articles that is acceptable. If the function of the article is so important that no nonconformers can be tolerated, acceptance sampling cannot be used. In these cases, every article must be inspected, and, to guard against error, may have to be inspected twice.

3.8 The protection that an attributes sampling plan provides against accepting an undesirable number of nonconforming articles is determined by the size of the sample and by the acceptance number. The protection provided by a plan is usually expressed in the form of an operating characteristic (OC) curve. Fig. 1 is the OC curve for the plan that calls for a sample of 55 articles and an acceptance number of two. Plotted along the horizontal axis is the quality level of an inspection lot expressed as the percentage of the articles in the lot that are nonconforming (Note 1). The vertical axis is the probability, as a percentage, that an inspection lot will be accepted by the plan (Note 4). Inspection lots with zero percent nonconforming articles will be accepted 100 % of the time (Note 2). As the percentage of nonconforming articles in the inspection lot increases, the probability of acceptance decreases. For example, as shown in Fig. 1, an inspection lot containing 1.5 % nonconforming articles has a 95 % chance of being accepted, while one containing 9.6 % nonconforming articles has only a 10 % chance of being accepted.

NOTE 4—The vertical axis of the OC curve can have two meanings. One is the probability that a particular inspection lot will be accepted. The other meaning is the percentage of a series of lots of a given quality level that will be accepted. The latter meaning is the one that is strictly correct mathematically. The former meaning is also correct, as long as the inspection lot is at least ten times bigger than the sample.

3.9 The characteristics of a sampling plan are often expressed in terms of the Acceptable Quality Level (AQL) and the Limiting Quality Level (LQL). The AQL is the quality level that will result in the acceptance of a high percentage of incoming inspection lots; usually it is the quality level that will result in the acceptance of 95 % of the incoming inspection lots. In Fig. 1, the AQL is 1.5 %. The LQL is the quality level

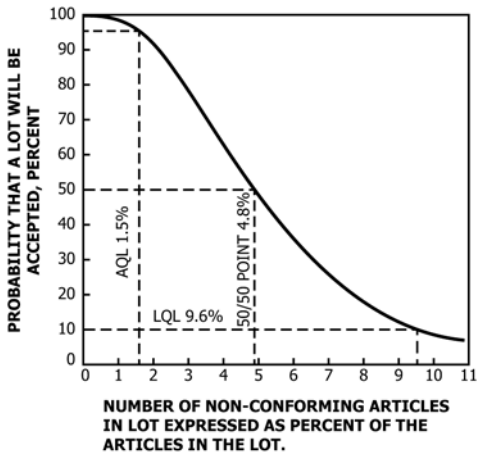


FIG. 1 Operating Characteristic Curve for Single Sample, Attributes Sampling Plan, Sample Size = 55, Acceptance Number = 2

that will result in the rejection of a high percentage of incoming inspection lots; usually it is the quality level that will result in the rejection of 90 % of the incoming inspection lots. In Fig. 1 the LQL is 9.6 %. In this standard, AQL and LQL are defined as the quality levels that will be accepted 95 and rejected 90 % of the time, respectively.

3.10 Another characteristic of sampling plans that is used in this standard is the 50/50 point. This is the quality level that will result in the acceptance of half of the incoming inspection lots. In Fig. 1 the 50/50 point is 4.8 %.

3.11 *Rectifying Inspection:*

3.11.1 As stated in 3.4, one of the options when an inspection lot is rejected is screening of the lot. In this procedure, called rectifying inspection, all of the articles in a rejected lot are inspected and the nonconforming ones are removed and replaced with conforming articles. The now 100 %-conforming inspection lot is accepted and is passed along with the inspection lots that were accepted on the basis of acceptance sampling. The addition of these 100 %-conforming inspection lots improves the average quality level of all the inspection lots taken together. The amount the quality level is improved can be calculated if the average quality level of incoming inspection lots is known. The calculations reveal that if the incoming quality level is high, few inspection lots will be rejected and screened and so the average quality of the outgoing lots will be only slightly improved over the incoming. If the quality level of the incoming inspection lots is low, many of the inspection lots will be rejected and screened. The addition of this large number of 100 %-conforming lots will result in a high outgoing quality level. At intermediate incoming quality levels, the outgoing quality will be poorer than these two extremes, and there will be a particular incoming quality level for which the outgoing level will be the poorest.

3.11.2 When rectifying inspection is used the average quality level of a series of outgoing lots is called the Average Outgoing Quality (AOQ) and the worst possible AOQ for a given plan is called the Average Outgoing Quality Limit (AOQL). Fig. 2 is a plot of the AOQ for the sampling plan of Fig. 1 (Note 5). This shows that the worst AOQ, the AOQL, is 2.5 % and occurs only if the average incoming quality level is 4.2 %. Fig. 2 also shows that when the quality level of incoming lots is high, the improvement caused by inspection is small. For example, if the incoming lots are of AQL quality, 1.5 %, the AOQ is 1.4 %. At lower incoming quality levels the relative improvement is greater; for example, at an incoming quality level of 3 %, the AOQ is 2.3 %.

NOTE 5—The AOQs and AOQLs in this guide are calculated on the basis that when rejected lots are screened the nonconforming articles found are replaced with conforming articles. If the discarded nonconforming articles are not replaced, a practice that is frequently done, the AOQs and AOQLs will be somewhat different from those in this guide. Chapter 16 of Ref (**4**) discusses this point.

3.11.3 Use of rectifying inspection will assure that with a continuous series of inspection lots the average quality level of all the accepted articles, considered as a whole, will not be worse than the AOQL of the sampling plan used. However, rectifying inspection can significantly increase inspection costs since every rejected inspection lot is 100 % inspected. The lower the quality of incoming lots, the more of them that will be rejected and then 100 % inspected. Fig. 3 shows how, for the sampling plan of Fig. 1 and lots of 550, the average number of articles inspected per inspection lot increases as the quality levels of incoming lots decrease. In lots containing up to about 1.5 % nonconforming articles the increase in inspection is moderate. Beyond that point the average amount of inspection increases rapidly. At an incoming quality level of 2.1 % the amount of inspection is doubled. And with incoming quality levels of 15 % virtually every inspection lot is 100 % inspected.

3.11.4 Because the cost of inspection using rectifying inspection plans is so greatly influenced by the quality level of incoming inspection lots, past information of that level is necessary before choosing an AOQL. The AOQL plans in Table 1 give the range of incoming quality level for which each plan is recommended. The cost of the inspection is also determined by the size of the inspection lot and by the size of the sample. If rectifying inspection is to be used on a large scale, it is recommended that the user refer to Ref (**3**). It contains plans that yield the lowest total inspection for each combination of AOQL, incoming quality level, and inspection lot size.

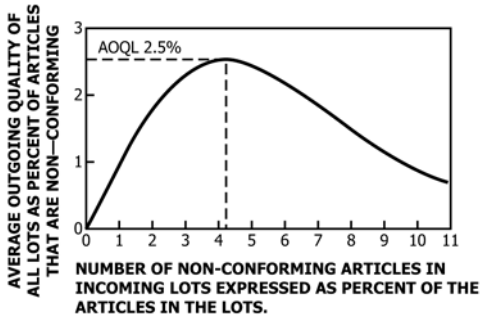


FIG. 2 Average Outgoing Quality of Rectifying Inspection with Single Sample, Attributes Plan, Sample Size = 55, Acceptance Number = 2. Rejected Lots Are 100% Inspected with Nonconforming Articles Removed and Replaced with Conforming Articles

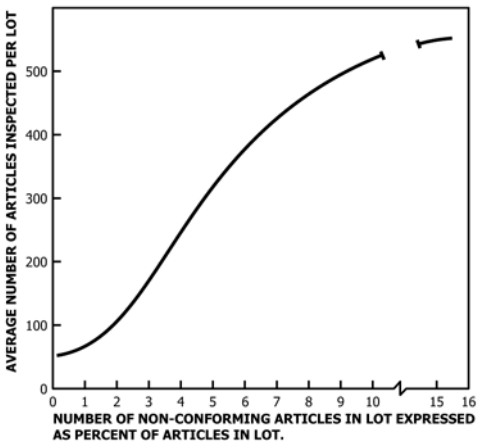


FIG. 3 Average Number of Articles Inspected Per Lot with Rectifying Inspection, Single Sampling, Attributes Plan with Sample Size = 55, Acceptance Number = 2, and Lot Size = 550

TABLE 1 Constant AQL Plans

NOTE 1—The values listed in columns headed AQL, 50/50 Point, LQL, and AOQL are the percentages of nonconforming articles in the inspection lot.

NOTE 2—The AOQL values are calculated for inspection lots that are very large compared to the sample. The values can be corrected for cases where this is not true by multiplying them by:

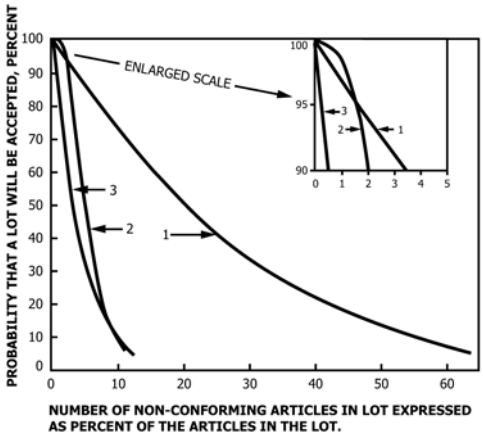
$$1 - \frac{\text{sample size}}{\text{lot size}}$$

AQL	Sample Size	Acceptance Number	50/50 Point	LQL	AOQL
0.25	145	1	1.2	2.7	0.6
	325	2	0.8	1.6	0.4
0.65	55	1	3.1	6.9	1.5
	126	2	2.1	4.2	1.2
	210	3	1.7	3.2	0.92
	303	4	1.5	2.6	0.84
	612	7	1.3	1.9	0.73
1.5	24	1	7.0	15	3.5
	55	2	4.9	9.4	2.5
	92	3	4.0	7.1	2.1
	132	4	3.5	6.0	1.9
	174	5	3.3	5.3	1.8
	365	7	2.9	4.4	1.7
4.0	9	1	19	37	9.3
	21	2	13	22	6.5
	35	3	10	18	5.5
	50	4	9.3	15	5.1
	66	5	8.6	14	4.8
	84	6	7.9	12	4.5

3.11.5 Whether the 100 % inspection of rejected lots is done by the purchaser or the supplier is a business decision of the purchaser. Having the supplier do the inspection provides an incentive to improve the quality of future lots. However, if the supplier does the 100 % inspection, the purchaser may want to do sampling inspection of screened lots. This adds even more to the cost of inspection.

3.11.6 Rectifying inspection, of course, cannot be used if the inspection methods destroy the inspected articles.

3.12 AQL and LQL plans with an acceptance number of zero are not included in this guide because their operating characteristics are different from plans that have acceptance numbers of one or more. They can provide LQL protection against the bad inspection lot but only at the cost of rejection of a large number of good lots. Or, if they are selected on a basis of the AQL, they will allow the acceptance of a large number of bad lots. Fig. 4 illustrates this. The OC curves of three plans are shown. Curve number 2 is the plan shown in Fig. 1, a sample of 55 and an acceptance number of two. Curve number 1 is the zero acceptance number plan that has the same AQL, 1.5 %, as curve number 2. The sample size is 3. But this plan has an LQL of 54 % as compared to 9.7 % for curve number 2. Curve number 3 is the zero acceptance number plan that has the same LQL as curve number 2. The sample size is 23. With this plan the AQL is 0.2 % as compared to 1.5 % for curve number 2.



NOTE 1—Curve 2 is the plan shown in Fig. 1. Curve 1 is a plan with a sample size of three and an acceptance number of zero; it has the same AQL as Curve 2 and an LQL of 54 %. Curve 3 is a plan with a sample size of 23 and an acceptance number of zero; it has the same LQL as Curve 2 and an AQL of 0.22 %. The inset in the upper right is an enlargement of the AQL region.

FIG. 4 Operating Characteristic Curves of Three Single Sample Attributes Sampling Plans

4. Selection of the Type of Sampling Plan

4.1 The sampling plans of this guide are given in Table 1, Table 2, and Table 3. All are single sampling plans, that is, the decision is based on the results with a single sample. Each table contains several sets of plans. Within each set the plans have one characteristic in common. In Table 1 all of the plans in a set have the same AQL. In Table 2 they have the same LQL. And in Table 3 the plans in each set have the same AOQL.

TABLE 2 Constant LQL Plans

NOTE 1—The values listed in columns headed AQL, 50/50 Point, LQL, and AOQL are the percentages of nonconforming articles in the inspection lot.

NOTE 2—The AOQL values are calculated for inspection lots that are very large compared to the sample. The values can be corrected for cases where this is not true by multiplying them by:

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

LQL	Sample Size	Acceptance Number	AQL	50/50 Point	AOQL
5.0	76	1	0.47	2.2	1.1
	105	2	0.78	2.5	1.3
	130	3	1.1	2.8	1.5
10	37	1	0.97	4.5	2.3
	52	2	1.6	5.1	2.6
	65	3	2.1	5.6	3.0
	78	4	2.6	6.0	3.4
15	24	1	1.5	7.0	3.5
	34	2	2.4	7.8	4.0
	43	3	3.2	8.5	4.5
	51	4	3.9	9.2	5.0
20	18	1	2.0	9.3	4.7
	25	2	3.4	11	5.5
	31	3	4.5	12	6.2
	38	4	5.2	12	6.7

TABLE 3 Constant AOQL Plans

NOTE 1—The values listed in columns headed AQL, 50/50 Point, LQL, and AOQL are the percentages of nonconforming articles in the inspection lot.

NOTE 2—The AOQL values are calculated for inspection lots that are very large compared to the sample. The values can be corrected for cases where this is not true by multiplying them by:

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

AOQL	Quality Level of Process	Sample Size	Acceptance Number	AQL	50/50 Point	LQL
0.65	0.0–0.1	57	0	0.09	1.2	4.1
	0.1–0.4	129	1	0.28	1.3	3.0
	0.4–0.6	211	2	0.39	1.3	2.5
1.0	0.0–0.2	37	0	0.14	1.9	6.2
	0.2–0.6	84	1	0.42	2.0	4.6
	0.6–0.9	137	2	0.60	1.9	3.8
2.5	0.0–0.5	15	0	0.34	4.6	15
	0.5–1.6	34	1	1.1	4.9	11
	1.6–2.2	55	2	1.5	4.9	9.4
4.0	0.0–0.9	9	0	0.57	7.7	26
	0.9–2.6	21	1	1.7	8.0	17
	2.6–3.6	35	2	2.4	7.6	14
6.5	0.0–1.3	6	0	0.86	12	38
	1.3–4.2	13	1	2.8	13	27
	4.2–6.0	21	2	4.0	13	23

4.2 Plans based on the AQL (Table 1) are usually selected when there is a continuing series of inspection lots from a single source. The AQL value selected is the quality level that the purchaser considers to be satisfactory. The supplier knows that if he operates his finishing process so that the average quality level of his output is as good as or better than the AQL, 95 % or more of his submitted lots will be accepted. The cost to the supplier of high rejection rates if the quality of his output is much worse than the AQL provides motivation to improve the quality. When AQL plans are used, the specific AQL chosen is often a mutual decision of the purchaser and the seller.

4.3 Plans are based on the LQL (Table 3) when the purchaser considers it important to be protected against accepting an individual bad inspection lot, the bad inspection lot being defined as one of LQL quality.

4.4 AOQL plans are usually used when a series of lots from a single source are accumulated to form a large stock of product. The AOQL plans assure that the quality level of the accumulated stock is not worse than the AOQL. Such plans are more commonly used internally by a manufacturer to inspect the output of a manufacturing process.

5. Selection of a Specific Plan

5.1 After the type of plan (AQL, LQL, or AOQL) is selected, a specific plan must be selected. Several factors need be taken into consideration.

5.2 The cost of inspection should be balanced against the cost that results from the acceptance of nonconforming product. In the absence of other considerations the plan chosen should be the one that yields the lowest total cost. Often a smaller sample will be used when a test method is destructive because destruction of the tested articles increases the cost of inspection. The fact that a test is destructive does not by itself, however, justify using smaller samples. It is just one of the factors in the analysis leading to the selection of the sampling plan.

5.3 Often larger samples are used with larger inspection lots because, even though the absolute cost of inspection is higher with larger samples, the inspection cost per unit of product is less (6.3). The larger samples give better discrimination between acceptable and unacceptable inspection lots. This better discrimination may be desirable with large lots because the consequences of the decision are greater. It must be kept in mind that changing the sample size changes the characteristics of the plan. With a constant AQL plan (Table 1), increasing the sample size decreases the 50/50 point and the LQL, yielding better overall protection to the purchaser. But with a constant LQL plan (Table 2) increasing the sample size increases the AQL and the 50/50 point, yielding poorer overall protection to the purchaser.

5.4 The quality history of a supplier is a consideration. If an AQL plan is used and experience shows that a supplier consistently produces at the AQL then the AQL plan with the smallest sample size may be the best choice. For example, from Table 1 using an AQL of 1.5 %, the plan with a sample size of 24 and acceptance number of one would be appropriate. With a new supplier an intermediate plan might be initially selected and then adjusted up or down the table based on the experience with the first several shipments. If a supplier has a very good quality history, it may be safe to inspect only some of the inspection lots. Whether to inspect a specific lot should be decided by chance, for example, by a coin flip.

5.5 It may be safe to accept incoming lots without inspection if a nonconforming article will be recognized at a subsequent step in manufacturing, at which step as the operator finds nonconforming articles, he sets them aside for disposition. An example is the appearance of a decorative finish. Such a practice should be provided for in the purchase contract.

5.6 Different sample size and acceptance number plans can be used for the several requirements that a finish must meet. For example, in some applications conformance to a thickness requirement may be more important than conformance to an appearance requirement. In such a case a tighter plan might be used for thickness and a looser one for appearance. However, the increased administrative cost of using two or more sample sizes may be greater than the savings.

5.7 The inherent quality level of the finishing process must be considered so that unreasonable quality demands are not made.

5.8 The selection of the sampling plan or sampling plans should be a part of the contract between the purchaser and the seller. When a sampling plan is used by an organization to inspect the output of its captive finishing department, the plans used should be arrived at in consultation with the management of the finishing department.

6. Selection of the Inspection Lot

6.1 It is important that the inspection lot be homogeneous. This means that the articles in the inspection lot are from a single supplier, from a single finishing line, and ones that were finished at the same time in one batch or produced during a single period of time.

6.2 There are several reasons homogeneity is necessary in inspection lots:

6.2.1 If lots of different quality levels are mixed before inspection, the resulting larger lot will have an average quality level that is between the best and the worst of the lots before they were mixed. This average quality will be the best that will be realized if the lot is accepted. If, however, the individual lots are inspected separately, the better ones will probably be accepted and the poorer ones rejected, so the average quality level of the accepted lots will be higher than had they been mixed.

6.2.2 If lots from different sources are combined before inspection and the combined lot is then rejected, it cannot be returned to its sources since the identities of the sources are lost.

6.2.3 Forming inspection lots by the source, by the finishing line, and by the batch or period of production provides quality information about the source, the finishing line, and the batch or period of production.

6.3 It is generally best for inspection lots to be as large as possible provided they are homogeneous. With larger lots larger samples can be used. This gives better discrimination between acceptable and unacceptable lots at lower unit costs. For example, assume a 1.5 % AQL plan is used (Table 1). If inspection lots contain 1000 articles and a sample of 55 is selected, the LQL will be 9.4 %, and 5.5 % of the articles will be inspected. If the inspection lots are larger, say 2000 articles, and a sample of 92 is used, the LQL is reduced to 7.1 % and the percentage of articles inspected is reduced to 4.6 % (5.3).

7. Sampling

7.1 Once the sampling plan is selected and the inspection lot is formed, the sample is drawn from the lot. It is essential that the articles in the sample be selected at random. This means that the selection of an article is purely by chance and that the chance of selection is the same for every article regardless of whether it is at the top or at the botttom of the lot, whether it looks good or looks bad, whether it is in reach or not, etc.

7.2 If the articles in a lot are thoroughly mixed as, for example, barrel electroplated articles, a sample drawn anywhere from the lot will meet the requirement of randomness. If the articles are not mixed, and if it is impractical to mix them, bias will result if the sample is drawn from a single or a few layers. Other bias in sampling, such as taking articles from the same place on a plating rack, taking articles from the output of one electroplating tank and not others, and taking articles that appear to be conforming or to be noncon forming, must be avoided. Bias can be avoided by numbering the articles, randomly selecting a group of numbers equal to the sample size, and inspecting the articles with the selected numbers. Ways of doing this are described in the following.

7.3 When random numbers are used to select a sample, each article in the lot is identified by a different number. This may be done by placing the articles in racks or trays where the positions in the racks or trays are numbered. If the articles have serial numbers, these can be used. The numbers of the articles that are to be inspected are selected randomly from a table of random numbers, such as Table 4. Other tables can be found in books dealing with statistics. Also, there are pocket calculators that can generate random numbers.

7.4 As an example, assume that a sample of 13 articles is to be selected from an inspection lot of 80 articles. The articles are numbered 1 through 80. Table 4 then can be used this way. Write the numbers 1 through 14 on 14 slips of paper, and write the numbers 1 through 61 on 61 other slips. Put each group into a container and blindly draw one slip from each group. The number drawn from the group of 14 determines the column number in Table 4. The number from the group of 61 is the row. Assume column 4 and row 30 are drawn. Going to Table 4, the number is found to be 94 305. To decide whether to read up or down the table, flip a coin, with heads the decision to go up and with tails, down. Assume the coin flip is tails. The numbers are chosen as follows: Consider only the first two digits of each group of five because the inspection lot contains 80 articles and only two-digit numbers are needed. Numbers larger than 80 are rejected and numbers that appear more than once are rejected after the first time. The samples of 13 articles, then, if found to be: 77, 56, 55, 12, 30, 49, 78, 64, 46, 67, 7, 29, 31.

7.5 When product articles are arranged in an order without regard to quality, such as in a tray, a sample can be drawn by using a constant-interval procedure. Here, a constant interval is maintained between the articles drawn for the sample. For example, every 9th, 16th, or 24th unit is selected. The first articles drawn from the lot can be determined from the table of random numbers. All other articles are then drawn at a constant interval following the first one. The constant interval is determined by dividing the inspection lot size by the sample size. Care must be taken to guard against a cyclic condition in the lot. For example, if the articles are received packed individually in a box, the articles in the corners of the box may be of poorer quality because of rough handling. If articles are rack-plated and are removed from the plating rack in a fixed sequence, constant interval sampling may result in selecting articles from the same location on the rack.

7.6 As an example of constant-interval sampling, assume that an inspection lot of 3000 articles is to be visually examined for freedom from blisters, pits, nodules, porosity, and staining. A sample of 126 is to be drawn. The constant interval is 23 (3000 divided by 126 is 23.8; round down to 23). A random number from 1 to 23 is selected either from a table (for example, Table 4) or by another appropriate method. After the first article is taken, the remaining articles in the required sample are drawn by selecting every 23rd article from the inspection lot until 126 are selected.

8. Inspection of the Sample

8.1 Each article in the sample is inspected from conformance to each of the finishing specification requirements and

TABLE 4 Table of Random Numbers

Row	Column													
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
1	10480	15011	01536	02011	81647	91646	69179	14194	62590	36207	20969	99570	91291	90700
2	22368	46573	25595	85393	30995	89198	27982	53402	93965	34095	52666	19174	39615	99505
3	24130	48360	22527	97265	76393	64809	15179	24830	49340	32081	30680	19655	63348	58629
4	42167	93093	06243	61680	07856	16376	39440	53537	71341	57004	00849	74917	97758	16379
5	37570	39975	81837	16656	06121	91782	60468	81305	49684	60672	14110	06927	01263	54613
6	77921	06907	11008	42751	27756	53498	18602	70659	90655	15053	21916	81825	44394	42880
7	99562	72905	56420	69994	98872	31016	71194	18738	44013	48840	63213	21069	10634	12952
8	96301	91977	05463	07972	18876	20922	94595	56869	69014	60045	18425	84903	42508	32307
9	89579	14342	63661	10281	17453	18103	57740	84378	25331	12566	58678	44947	05585	56941
10	85475	36857	53342	53988	53060	59533	38867	62300	08158	17983	16439	11458	18593	64952
11	28918	69578	88231	33276	70997	79936	56865	05859	90106	31595	01547	85590	91610	78188
12	63553	40961	48235	03427	49626	69445	18663	72695	52180	20847	12234	90511	33703	90322
13	09429	93969	52636	92737	88974	33488	36320	17617	30015	08272	84115	27156	30613	74952
14	10365	61129	87529	85689	48237	52267	67689	93394	01511	26358	85104	20285	29975	89868
15	07119	97336	71048	08178	77233	13916	47564	81056	97735	85977	29372	74461	28551	90707
16	51085	12765	51821	51259	77452	16308	60756	92144	49442	53900	70960	63990	75601	40719
17	02368	21382	52404	60268	89368	19885	55322	44819	01188	65255	64835	44919	05944	55157
18	01011	54092	33362	94904	31273	04146	18594	29852	71585	85030	51132	01915	92747	64951
19	52162	53916	46369	58586	23216	14513	83149	98736	23495	64350	94738	17752	35156	35749
20	07056	97628	33787	09998	42698	06691	76988	13602	51851	46104	88916	19509	25625	58104
21	48663	91245	85828	14346	09172	30168	90229	04734	59193	22178	30421	61666	99904	32812
22	54164	58492	22421	74103	47070	25306	76468	26384	58151	06646	21524	15227	96909	44592
23	32639	32363	05597	24200	13363	38005	94342	28728	35806	06912	17012	64161	18296	22851
24	29334	27001	87637	87308	58731	00256	45834	15398	46557	41135	10367	07684	36188	18510
25	02488	33062	28834	07351	19731	92420	60952	61280	50001	67658	32586	86679	50720	94953
26	81525	72295	04839	96423	24878	82651	66566	14778	76797	14780	13300	87074	79666	95725
27	29676	20591	68086	26432	46901	20849	89768	81536	86645	12659	92259	57102	80428	25280
28	00742	57392	39064	66432	84673	40027	32832	61362	98947	96067	64760	64584	96096	98253
29	05366	04213	25669	26422	44407	44048	37937	63904	45766	66134	75470	66520	34693	90449
30	91921	26418	64117	94305	26766	25940	39972	22209	71500	64568	91402	42416	07844	69618
31	00582	04711	87917	77341	42206	35126	74087	99547	81817	42607	43808	76655	62028	76630
32	00725	69884	62797	56170	86324	88072	76222	36086	84637	93161	76038	65855	77919	88006
33	69011	65795	95876	55293	18988	27354	26575	08625	40801	59920	29841	80150	12777	48501
34	25976	57948	29888	88604	67917	48708	18912	82271	65424	69774	33611	54262	85963	03547
35	09763	83473	73577	12908	30883	18317	28290	35797	05998	41688	34952	37888	38917	88050
36	91567	42595	27958	30134	04024	86385	29880	99730	55536	84855	29080	09250	79656	73211
37	17955	56349	90999	49127	20044	59931	06115	20542	18059	02008	73708	83517	36103	42791
38	46503	18584	18845	49618	02304	51038	20655	58727	28168	15475	56942	53389	20562	87338
39	92157	80634	94824	78171	84610	82834	09922	25417	44137	48413	25555	21246	35509	20468
40	14577	62765	35605	81263	39667	47358	56873	56307	61607	49518	89656	20103	77490	18062
41	98427	07523	33362	64270	01638	92477	66969	98420	04880	45585	46565	04102	46880	45709
42	34914	63976	88720	82765	34476	17032	87589	40836	32427	70002	70663	88863	77775	69348
43	70060	28277	39475	46473	23219	53416	94970	25832	69975	94884	19661	72828	00102	66794
44	53976	54914	06990	67245	68350	82948	11398	42878	80287	88267	47363	46634	06541	97809
45	76072	29515	40980	07391	58745	25774	22987	80059	39911	96189	41151	14222	60697	59583
46	90725	52210	83974	29992	65831	38857	50490	83765	55657	14361	31720	57375	56228	41546
47	64364	67412	33339	31926	14883	24413	59744	92351	97473	89286	35931	04110	23726	51900
48	08962	00358	31662	25388	61642	31072	81249	35648	56891	69352	48373	45578	78547	81788
49	95012	68379	93526	70765	10592	04542	76463	54328	02349	17247	28865	14777	62730	92277
50	15664	10493	20492	38391	91132	21999	59516	81652	27195	48223	46751	22923	32261	85653
51	16408	81899	04153	53381	79401	21438	83035	92350	36693	31238	59649	91754	72772	02338
52	18629	81953	05520	91962	04739	13092	97662	24822	94730	06496	35090	04822	86774	98289
53	73115	35101	47498	87637	99016	71060	88824	71013	18735	20286	23153	72924	35165	43040
54	57491	16703	23167	49323	45021	33132	12544	41035	80780	45393	44812	12515	98931	91202
55	30405	83946	23792	14422	15059	45799	22716	19792	09983	74353	68668	30429	70735	25499
56	16631	35006	85900	98275	32388	52390	16815	69298	82732	38480	73817	32523	41961	44437
57	96773	20206	42559	78985	05300	22164	24369	54224	35083	19687	11052	91491	60383	19746
58	38935	64202	14349	82674	66523	44133	00697	35552	35970	19124	63318	29686	03387	59846
59	31624	76384	17403	53363	44167	64486	64758	75366	76554	31601	12614	33072	60332	92325
60	78919	19474	23632	27889	47914	02584	37680	20801	72152	39339	34806	08930	85001	87820
61	03931	33309	57047	74211	63445	17361	62825	39908	05607	91284	68833	25570	38818	46920

each article is classified as either conforming or nonconforming with respect to each requirement.

8.2 For each requirement in turn, articles that are nonconforming to the requirement are counted. For each requirement that the number of nonconforming articles is no more than the acceptance number of the sampling plan, the inspection lot is accepted with respect to that requirement. If for any requirement the number of nonconforming articles is more than the acceptance number, the lot is rejected with respect to that requirement.

8.3 Note that the inspection lot is classified as accepted or rejected with respect to each requirement separately. Thus if, for example, a plan is used with a sample size of 55 and acceptance number of 2, and if in inspection one article is

found nonconforming with respect to coating thickness, another with respect to coating adhesion, and a third with respect to appearance, the inspection lot is accepted because although three articles are nonconforming, no more than one is nonconforming with respect to any one requirement. If, on the other hand, three articles are nonconforming with respect to a single requirement, say thickness, the lot is rejected.

9. Disposition of Lot

9.1 An inspection lot that is acceptable with respect to all requirements, is accepted.

9.2 An inspection lot that is unacceptable with respect to one or more of the requirements, is rejected. If the sampling plan used is an AQL is an LQL plan, the buyer must decide what to do with the lot (3.4).

9.3 If an inspection lot is rejected with respect to one or more of the requirements and an AOQL sampling plan is being used, all of the articles are inspected for the requirement or requirements for which the inspection lot was rejected. All nonconforming articles are removed from the inspection lot, replaced with conforming articles, and the lot is then accepted (Note 5).

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(1) Bowker, A. H., and Goode, H. P., *Sampling Inspection by Variables*, McGraw-Hill Book Co., New York, NY, 1952.

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(4) Military Handbook MIL-HDBK-53, "Guide for Sampling Inspection."

(5) General Services Administration Handbook FSS P4440.1 "Guide for the Use of MIL-STD-105."

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