

Guide for the selection of an acceptance sampling system, scheme or plan for inspection of discrete items in lots

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Committees responsible for this British Standard

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Contents

	Page
Committees responsible	Inside front cover
National foreword	ii
Introduction	v
Guide	
1 Scope	1
2 References	2
3 The selection process	3
4 Acceptance sampling systems, schemes and plans	4
5 ISO Standards for 'acceptance sampling' of lots	4
6 Some general considerations influencing a selection	9
7 Making a comparison of the methods for sampling inspection	30
8 Other methods sometimes adopted in practice	38
9 Market and production conditions — effect on the selection process	39
10 The final selection — realism	47
Annexes	
A Bibliography	48
Figures	
1 Operating characteristic curve defined by producer's risk (PR) and consumer's risk (CR)	19
2 Operating characteristic curve defined by acceptable quality level (AQL) and limiting quality (LQ)	19
3 OC curves: Four sampling plans for AQL 1,5 % nonconforming, normal inspection, single sampling	21
4 Normal distribution	31
5 Distribution with large positive skewness	31
6 Comparison of operating characteristic curves for single, double, multiple and sequential sampling plans (code letter L, AQL 0,65 %)	35
7 Comparison of average sample sizes for single, double, multiple and sequential sampling (for acceptance plans of figure 6)	37
8 Chart illustrating the selection procedures when production is continuous and run length exceeds 10 lots of original inspection	44
9 Chart illustrating the selection procedures when production is not continuous or run is 10 lots or fewer	45
Tables	
1 Comparison of sample sizes in inspection by attributes and by variables	30
2 Equivalent sampling plans for code letter L, AQL 0,65	36
3 Guide for selection of a candidate acceptance sampling system, scheme or plan based on the inspection situation	41
4A Guide for the selection of an acceptance sampling system, scheme or plan, using existing market conditions	42
4B Guide for the selection of an acceptance sampling system, scheme or plan, using existing production conditions	43

National foreword

This British Standard has been prepared by Technical Committee SS/5. It is identical with ISO TR 8550 *Guide for the selection of an acceptance sampling system, scheme or plan for inspection of discrete items in lots*, published by the International Organization for Standardization (ISO) and supersedes BS 6000 : 1972 which is withdrawn.

Whereas BS 6000 : 1972 dealt exclusively with sampling inspection by attributes, the scope of this new edition of BS 6000 has been extended to include sampling inspection by variables. A new edition of the guide to acceptance sampling by attributes is now designated BS 6001 : Part 0 : 1996.

The primary purpose of this British Standard is to give guidance in the selection of an acceptance sampling system, scheme or plan. It does this principally in the context of existing British Standards. It reviews the available systems and shows ways in which they can be compared in order to assess their suitability for an intended application. The guide also indicates how prior knowledge of the manufacturing or service delivery process and quality performance could influence the choice of the sampling system, scheme or plan, and likewise how the particular needs of the customer affect the selection. Some specific circumstances encountered in practice are described and the method of choosing a plan is explained. Some check lists or pointers and tables are provided to assist users in selecting an appropriate system, scheme or plan for their purpose. Two charts are included to illustrate the procedures followed in the selection process.

Update on references. Since the publication of ISO TR 8550, International Standards ISO 8402 : 1994 and ISO 2859-0 : 1995 have been published. The footnotes appearing against these publications in clause 2 can therefore be deleted. The entry for ISO 2859-0 in this clause should be extended with the year of publication, i.e. ' : 1995'. In addition, developments in the ISO 9000 series also necessitate some changes in annex A as follows.

[2] ISO 9000 has now been published in four Parts, of which Part 1 and Part 2 are relevant:

ISO 9000-1	<i>Quality management and quality assurance standards</i> Part 1 : 1994 <i>Guidelines for selection and use</i>
ISO 9000-2	<i>Quality management and quality assurance standards</i> Part 2 : 1993 <i>Generic guidelines for the application of ISO 9001, ISO 9002 and ISO 9003</i>

[6] ISO 9004 has also been published in four Parts, all of which are considered to be informative in the context of this standard:

ISO 9004-1	<i>Quality management and quality system elements</i> Part 1 : 1994 <i>Guidelines</i>
ISO 9004-2	<i>Quality management and quality system elements</i> Part 2 : 1991 <i>Guidelines for services</i>
ISO 9004-3	<i>Quality management and quality system elements</i> Part 3 : 1993 <i>Guidelines for processed materials</i>
ISO 9004-4	<i>Quality management and quality system elements</i> Part 4 : <i>Guidelines for quality improvement</i>

Cross-references

International standard	Corresponding British Standard
ISO 2854 : 1976	BS 2846 <i>Guide to statistical interpretation of data</i> Part 4 : 1976 <i>Techniques of estimation and tests relating to means and variances</i> (Identical)
ISO 2859-0 : 1995	BS 6001 <i>Sampling procedures for inspection by attributes</i> Part 0 : 1996 <i>Introduction to the BS 6001 attribute sampling system</i> (Identical)

ISO 2859-1 : 1989	BS 6001 <i>Sampling procedures for inspection by attributes</i> Part 1 : 1991 <i>Specification for sampling plans indexed by acceptable quality level (AQL) for lot-by-lot inspection</i> (Identical)
ISO 2859-2 : 1985	BS 6001 <i>Sampling procedures for inspection by attributes</i> Part 2 : 1993 <i>Specification for sampling plans indexed by limiting quality (LQ) for isolated lot inspection</i> (Identical)
ISO 2859-3 : 1991	BS 6001 <i>Sampling procedures for inspection by attributes</i> Part 3 : 1993 <i>Specification for skip-lot procedures</i> (Identical)
ISO 3534-1 : 1993	BS ISO 3534 <i>Statistics. Vocabulary and symbols</i> Part 1 : 1993 <i>Probability and general statistical terms</i> (Identical)
ISO 3534-2 : 1993	BS ISO 3534 <i>Statistics. Vocabulary and symbols</i> Part 2 : 1993 <i>Statistical quality control</i> (Identical)
ISO 3951 : 1989	BS 6002 <i>Sampling procedures for inspection by variables</i> Part 1 : 1993 <i>Specification for single sampling plans indexed by acceptable quality level (AQL) for lot-by-lot inspection</i> (Identical)
ISO/DIS 5479	BS 2846 <i>Guide to statistical interpretation of data</i> Part 7 : 1984 <i>Test for departure from normality</i> (Technically equivalent)
ISO 8402 : 1994	BS EN ISO 8402 : 1995 <i>Quality management and quality assurance — Vocabulary</i> (Identical)
ISO 8422 : 1991	BS 6001 <i>Sampling procedures for inspection by attributes</i> Part 4 : 1994 <i>Specification for sequential sampling plans</i> (Identical)
ISO 8423 : 1991	BS 6002 <i>Specification procedures for inspection by variables</i> Part 4 <i>Specification for sequential sampling plans for percent nonconforming</i> Section 4.1 : 1994 <i>Known standard deviation</i> (Identical)

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Introduction

For the inspection of discrete items submitted in lots this International Technical Report gives guidance in the selection of an appropriate acceptance sampling scheme from those described in the relevant ISO standards.

There are many situations where products (materials, parts, components, assemblies and systems) are transferred from one organization to another, where the organizations may be different companies or parts of a single company or even different shops within a plant. In these situations both the supplier and the customer may use acceptance sampling procedures to satisfy themselves that the product is of acceptable quality. The supplier will be seeking to maintain a reputation for good quality and to reduce the likelihood of claims under warranty, but without incurring unnecessary production and supply costs. On the other hand, the customer will require adequate evidence, at minimum cost to himself, that the product he receives conforms to specification. Compared with, say, 100% inspection, suitable sampling methods will often be beneficial in achieving these aims. Sometimes acceptance sampling methods may be the only practical procedure, especially when the tests for conformance are destructive.

Several types of sampling systems, schemes and plans are available for these purposes. They are presented in a number of ISO Standards which explain how they are to be used. However, it is often difficult to decide on the most appropriate procedure for use in a particular situation. The purpose of this Technical Report is to assist in that decision.

The choice of which sampling system, scheme or plan to use depends on a number of conditions and the circumstances prevailing. In any supply situation the first essential is that the supplier and the customer understand, and have agreed, the requirements and the basis for release and acceptance of the product, including any acceptance sampling methods to be used.

The parties should agree on the following:

- (a) the specification to which the discrete items of product are to conform; this is necessary because in all dealings between the parties there has to be agreement on what constitutes a conforming item and what constitutes a nonconforming item;
- (b) whether the acceptance of the product is to be determined by the acceptance of individual items or collectively by the acceptance of inspection lots of items. Acceptance of individual items precludes sampling.

When the acceptance is to be on a lot basis, the agreement between supplier and recipient needs to include not only the criteria for item conformance but also the criteria for lot acceptance, the criteria for non-acceptance of the lot and the acceptance sampling system, scheme or plan to be used. The latter should be based on risk factors that are mutually acceptable between producer and customer.

Having agreed on the acceptance sampling system, scheme or plan to be used, the supplier knows, at various quality levels, the probability that his supply lots will be accepted. Likewise the customer understands the protection that the sampling system, scheme or plan gives him to prevent acceptance of poor quality product.

Lots that are not acceptable cause difficulties for both supplier and customer. The supplier incurs additional costs in rework, scrap, increased inspection, damage to reputation and he may suffer loss of sales. Delays in delivery and reinspection costs are a burden to the customer. For these reasons it is usually considered essential for the supplier to provide lots that have a very high probability of being accepted - 95% or more. The supplier has to ensure that quality control of the production or delivery process provides lots of a quality sufficient to meet this objective. A basic principle of some acceptance sampling inspection schemes is to promote the production of lots of acceptable quality. The primary purpose in these schemes is not to discriminate between acceptable and non-acceptable lots, i.e. to sort, but to keep production under control to yield an acceptable process average quality. Although all acceptance sampling plans are discriminatory to some degree, the process average quality (expressed in terms of percent nonconforming or number of nonconformities) should not be greater than half the acceptable quality level in order to ensure a very high probability of acceptance.

Guide for the selection of an acceptance sampling system, scheme or plan for inspection of discrete items in lots

1 Scope

The primary purpose of this Technical Report is to give guidance in the selection of an acceptance sampling system, scheme or plan. It does this principally in the context of existing ISO standards.

The guidance in this Technical Report is confined to acceptance sampling of products that are supplied in lots and that can be classified as consisting of discrete items (discrete articles of product). Each item in a lot can be identified and segregated from the other items in the lot and has an equal chance of being included in the sample. Each item of product is countable and has specific characteristics that are measurable or classifiable as being conforming or nonconforming (to a given specification).

The ISO Standards on acceptance sampling, and hence this Technical Report, are applicable to a wide variety of inspection situations. These include, but are not limited to, the following:

- (a) end items, such as complete products or sub-assemblies;
- (b) components and raw materials;
- (c) services;
- (d) materials in process;
- (e) supplies in storage;
- (f) maintenance operations;
- (g) data or records;
- (h) administration procedures.

Although the Technical Report is written principally in terms of manufacture and production, this should be interpreted liberally as it is applicable to the selection of sampling systems, schemes and plans for all types of product and processes as defined in ISO 8402.

2 References

- ISO 2854:1976 *Statistical interpretation of data - Techniques of estimation and tests relating to means and variances*
- ISO 2859-0¹⁾ *Sampling procedures for inspection by attributes*
Part 0: *Introduction to the ISO 2859 attribute sampling system*
- ISO 2859-1:1989 *Sampling procedures for inspection by attributes*
Part 1: *Sampling plans indexed by acceptable quality level (AQL) for lot-by-lot inspection*
- ISO 2859-2:1985 *Sampling procedures for inspection by attributes*
Part 2: *Sampling plans indexed by limiting quality (LQ) for isolated lot inspection*
- ISO 2859-3:1991 *Sampling procedures for inspection by attributes*
Part 3: *Skip-lot sampling procedures*
- ISO 3534-1:1993 *Statistics - Vocabulary and symbols*
Part 1: *Probability and general statistical terms*
- ISO 3534-2:1993 *Statistics - Vocabulary and symbols*
Part 2: *Statistical quality control*
- ISO 3951:1989 *Sampling procedures and charts for inspection by variables for percent nonconforming*
- ISO 8402:1994²⁾ *Quality management and quality assurance - Vocabulary*
- ISO 8422:1991 *Sequential sampling plans for inspection by attributes*
- ISO 8423:1991 *Sequential sampling plans for inspection by variables for percent nonconforming (known standard deviation)*

¹⁾ In preparation

²⁾ Publication imminent

3 The selection process

This Technical Report reviews the salient features of a number of sampling systems, schemes and plans and the specific applications for which they were designed. The task of selecting a suitable system, scheme or plan is influenced by production and marketing conditions. In addition, the economics of the sampling system, the resources of the inspection organization and other aspects need to be considered. Therefore, the selection process becomes complex and rarely is there one method of acceptance sampling that fits all situations even though they may appear to be similar.

In this Technical Report, tables 3, 4A and 4B, together with figures 8 and 9, illustrate the process for selecting a sampling system, scheme or plan. The tables provide 'candidate' sampling systems, schemes and plans to fit given inspection situations, production conditions and market conditions, respectively. The method suggested is to review tables 3, 4A and 4B and to select as many 'candidate plans' as fit the situation. These candidates should then be reviewed through figure 8 or 9 so that the user finally arrives at a system, scheme or plan that is most feasible and economic for the situation.

The initial selection decisions are for long and short runs, isolated lots, attribute or variables sampling; these decisions will lead to one or more possible ISO standards.

Figures 8 and 9 are not intended as flow charts. These figures show, in summary form, the procedures contained within each ISO Standard for arriving at a sampling system, scheme or plan. The summaries are listed side by side, which allows direct comparison between them. The solid connecting lines indicate the primary course to be followed in choosing and operating a standard, the broken lines indicate alternatives. These alternatives are applicable only under certain conditions. Text references and notes to the figures are given for guidance in following these procedures. The standards and procedures given below the horizontal line in each of the two figures are particularly for use when economy of average sample size is an important consideration.

The procedure presented in figure 8 is followed when production is continuous and there are more than 10 lots of product undergoing inspection. ISO 2859-1, ISO 8422, ISO 3951 and ISO 8423 are included here as potential 'candidate' systems.

Figure 9 is to be used when other conditions prevail, e.g. when there is no continuity of production, when the number of lots is 10 or fewer, when the warranty does not survive acceptance and/or when the presence of a small number of nonconforming items can result in a large loss.

A final selection should be based on both the requirements of the situation and the resources of the inspection organization.

In the process of selecting a system, scheme or plan, it is possible to find that the selection has indicated a system, scheme or plan that has one or more insurmountable deficiencies. This is a signal that the process needs to be repeated. The cases in which there is only one appropriate method are few. Iterative investigations will usually identify two or more methods. The most economic and appropriate one should be chosen.

4 Acceptance sampling systems, schemes and plans

An acceptance *sampling plan* is a set of rules by which a lot is to be inspected and 'sentenced'. The plan stipulates the number of items (units) in the sample, to be drawn randomly from a lot for inspection against the product specification. The lot is then sentenced as 'acceptable' or 'not acceptable' according to how the inspection results compare with the criteria of the acceptance sampling plan.

Sometimes, when a long series of lots is being inspected, a sampling procedure may call for a shift from one sampling plan to another, depending on the current and previous sample results. Sampling procedures that call for switching from one sampling plan to another, and possibly back again, are called *sampling schemes*. A sampling scheme may also call for discontinuation of inspection if product quality appears to remain poor. The customer may then shift to another supplier, if available, or initiate 100% screening until the supplier can upgrade the production process so as to produce acceptable product.

In the case of destructive testing, the customer may cease to accept product until the supplier has demonstrated that the production problems that were giving rise to the previous low quality have been overcome.

A collection of sampling plans and related sampling schemes constitute a *sampling system*. The system will be indexed in some way, e.g. by lot size, inspection level and acceptable quality level (cf. ISO 2859-1).

The current ISO Standards present plans for single, double, multiple or sequential sampling. Procedures for skip-lot sampling for inspection by attributes are given in ISO 2859-3. A comparison of the various sampling methods and the principles on which they are based will assist in assessing their suitability for a particular application and will enable an appropriate selection to be made.

5 ISO Standards for 'acceptance sampling' of lots

5.1 General

This clause presents in summary the salient features of each of the current ISO Standards concerned with acceptance sampling methods. The summaries of the scope and application of the available ISO Standards should enable a user to select those Standards which are most likely to suit a given purpose.

The comparisons between the various ISO Standard acceptance sampling systems in these summaries are not enough to allow a final selection of a system, scheme or plan to be made in a particular situation. Before this can be done a number of factors need to be understood and considered. These factors are reviewed in 6 and 7.

5.2 Sampling for inspection by attributes

Within this category the following ISO Standards are relevant:

- (a) ISO 2859-0 *Sampling procedures for inspection by attributes*
Part 0: *Introduction to the ISO 2859 attribute sampling system*

This is a companion document to this Technical Report and can be read in conjunction with it, if desired, but this is not essential. It is not a source of sampling schemes or plans.

ISO 2859-0 consists of two sections. Section 1 *General introduction to acceptance sampling* is essentially an introduction to the sampling schemes employed in ISO 2859 and ISO 8422 but it treats the subject in a general way. It contains explanations of terms, gives practical advice on sampling inspection and discusses some underlying concepts. Section 2 *The ISO 2859-1 system* extends Section 1 and amplifies the introductory text and instructions contained in ISO 2859-1, by giving detailed comments and examples to assist in using the procedures and tables that make up the ISO 2859-1 system.

(b) ISO 2859-1 *Sampling procedures for inspection by attributes*
 Part 1: Sampling plans indexed by acceptable quality level (AQL) for lot-by-lot inspection

This Part of ISO 2859 presents a sampling system indexed by lot-size ranges, inspection levels and AQLs and specifies sampling plans and procedures for inspection by attributes of discrete items. It contains sampling plans for single, double and multiple sampling indexed by percent nonconforming and nonconformities per 100 items.

ISO 2859-1 is intended to be used as a system employing tightened, normal and reduced inspection on a continuing series of lots to achieve customer protection while assuring the producer that, if quality is better than the AQL, acceptance will occur most of the time.

The objective in ISO 2859-1 is to induce a supplier, through the economic and psychological pressure of potential non-acceptance, to maintain a process average quality at least as good as the specified AQL, while at the same time providing an upper limit for the risk to the consumer of accepting the occasional lot of poor quality.

The continuing series of lots should be of sufficient duration to allow the switching rules to be applied. These rules provide for the following:

- an automatic protection to the customer (by means of a switch to tightened inspection or to discontinuation of inspection) in the event that an apparent deterioration in quality is detected;
- an incentive to reduce inspection costs (by means of a switch to reduced inspection - at the discretion of a Responsible Authority) if consistently good quality is being achieved.

The plans in ISO 2859-1 may also be used for the inspection of lots in isolation, but in this case the user is strongly advised to consult the operating characteristic curves to find a plan which will yield the desired protection. A much simpler procedure to follow in this type of situation is presented in ISO 2859-2.

- (c) ISO 2859-2 *Sampling procedures for inspection by attributes*
 Part 2: Sampling plans indexed by limiting quality (LQ)
 for isolated lot inspection

This Part of ISO 2859 establishes sampling plans indexed by limiting quality and procedures that can be used when the switching rules of ISO 2859-1 cannot be applied. The LQ is used to indicate the customer protection. The plans are primarily intended for use with single lots (procedure A), or lots isolated from a series (procedure B) where the switching rules are precluded. Both procedures treat the limiting quality as an indicator of the actual percentage nonconforming in the lots submitted. They can also be used to cover cases where quality is expressed in non-conformities per 100 items.

The two procedures provide for situations often met in practice. Procedure A is used when both the supplier and the customer wish to regard the lot in isolation and it is also used as the default procedure (i.e. it is used unless there is a specific instruction to use procedure B).

Procedure B is used when the supplier regards the lot as one of a continuing series, but the customer considers the lot received in isolation. The plans employed permit a producer to maintain consistent procedures for his customers, irrespective of whether the customers receive individual lots or a continuing series of lots. The manufacturer is concerned with all of the production but the individual customer only with the particular lot received.

For procedure A plans are identified by their lot size and LQ; for procedure B they are identified by lot size, LQ and inspection level.

Procedure A includes plans with an acceptance number of zero, whereas procedure B does not. Double and multiple sampling plans can be used as alternatives to single sampling plans in procedure B and for the non-zero acceptance number plans in procedure A.

- (d) ISO 2859-3 *Sampling procedures for inspection by attributes*
 Part 3: Skip-lot sampling procedures

This Part of ISO 2859 presents a sampling system that extends the procedures contained in ISO 2859-1. It provides a procedure for reducing the inspection effort on products submitted by suppliers who have demonstrated their ability to control, in an effective manner, all facets of product quality and to produce superior quality material consistently. However, this procedure is proscribed for the inspection of product characteristics that involve the safety of personnel.

The skip-lot programme uses the acceptance sampling plans described in ISO 2859-1 and is intended only for a continuing series of lots. It is totally inappropriate for isolated lots. All lots in the series are expected to be of a similar quality and the customer should have no reason to believe that lots not inspected are of a poorer quality than the ones inspected.

In a skip-lot sampling procedure some lots in a series are accepted without inspection when the sampling results for a stated number of immediately preceding lots meet stated criteria. The lots to be inspected are chosen randomly with a stated frequency, called the 'skip-lot frequency'.

(e) ISO 8422 *Sequential sampling plans for inspection by attributes*

This Standard presents a sampling system that provides a wide range of sequential sampling plans indexed in terms of the consumer's risk point (CRP) and the producer's risk point (PRP). It also contains a sequential sampling system indexed by lot size ranges, inspection levels and AQLs to supplement the system in ISO 2859-1, including switching rules. (For the relationship between AQL, LQ, CRP and PRP see figures 1 and 2, page 23.)

In sequential sampling the sample is formed by taking items randomly one after another until a decision point is reached. The decision that 'sentences' the lot acceptable or not acceptable can occur at almost any stage and for sequential sampling by attributes depends on the number of items inspected and the cumulative number of nonconforming items or nonconformities found up to that point.

This Standard provides procedures based on a sequential assessment of inspection results that may be used to induce the supplier - through the economic and psychological pressure of non-acceptance of lots of inferior quality - to supply lots of a quality with a high probability of acceptance while maintaining an upper limit for the risk to the consumer of accepting lots of poor quality.

The plans are intended primarily for use in inspection of a continuing series of lots from the same production run. Subject to certain provisions the plans may also be used for the inspection of lots in isolation.

In terms of the average number of items inspected per lot, this Standard offers plans that are more economic than those in ISO 2859-1, albeit at the expense of an increase in administrative complication.

5.3 Sampling for inspection by variables

In sampling for inspection by variables, the product characteristic of each item in the sample is measured. The criterion for lot acceptance is based on an assessment of the percentage nonconforming determined from the average and variability of the measurements. Within this category the following ISO Standards are relevant:

(a) ISO 3951 *Sampling procedures and charts for inspection by variables for percent nonconforming*

This Standard presents a sampling system indexed by lot size ranges, inspection levels and AQLs and is complementary to ISO 2859-1. The two Standards share a common philosophy and purpose. ISO 3951 is intended primarily for the inspection of a continuing series of lots from one source of sufficient duration to allow the switching rules to operate, but, like ISO 2859-1, it can also be used for lots of an isolated nature.

It is only applicable where a single product characteristic, measurable on a continuous scale, is considered. The product characteristic should be distributed according to a normal distribution or to a distribution closely approximating normality ¹⁾. A lot is judged as unacceptable when the

¹⁾ Often a simple mathematical transformation, such as taking the logarithm or square root, will convert a set of measurements from a non-normal to a normal (or near normal) distribution.

distribution of the product characteristic fails to indicate an average and variability which meets the sampling criteria for the single or double specification limits prescribed. A choice is available between numerical and graphical acceptance criteria. Procedures are given for the case where the process standard deviation is known and also for the case where it is unknown. Guidance is given on how these procedures can be used in combination with sampling for inspection by attributes, the most important suitable product characteristic being sampled by variables.

ISO 3951 is intended primarily for the inspection of a continuing series of lots from one source of sufficient duration to allow the switching rules to operate, but, like ISO 2859-1, it can also be used for lots of an isolated nature. However, inspection carried out on an isolated lot will provide little evidence about the normality of the distribution of the product characteristic and about the standard deviation of the process. In practice, therefore, ISO 3951 does not apply to the inspection of isolated lots.

There are no double or multiple sampling plans in the current edition (1989) of this ISO Standard.

- (b) ISO 8423 *Sequential sampling plans for inspection by variables for percent nonconforming (known standard deviation)*

This Standard presents a sampling system providing a wide range of sequential sampling plans indexed in terms of the consumer's risk point (CRP) and the producer's risk point (PRP). It also contains a sequential sampling system indexed by lot size ranges, inspection levels and AQLs to supplement the system in ISO 3951, including switching rules. Like ISO 3951, ISO 8423 requires that the product characteristic should be distributed normally (see footnote on p.11).

The procedures in ISO 8423 are based on a sequential assessment of inspection results and may be used to induce a supplier - through the economic and psychological pressure of non-acceptance of lots of inferior quality - to supply lots of a quality with a high probability of acceptance while maintaining an upper limit for the risk to a consumer of accepting lots of poor quality.

The plans are intended primarily for use in the inspection of a continuing series of lots from the same production run. In theory, the Standard could be applied to an isolated lot. However, inspection carried out on an isolated lot will provide little evidence about the normality of the distribution of the product characteristic and about the standard deviation of the process. Therefore, in practice, the Standard does not apply to the inspection of isolated lots.

5.4 Advantages of specifying ISO standard sampling plans

To those concerned with the writing of specifications it is of benefit that statistically sound sampling procedures be provided. Because of the prime need to ensure that a sample is representative, most sampling schemes presented in the ISO Standards reviewed above relate sample size to lot size. Apart from providing control over the methods of selection of the sample, these Standards should normally be invoked because they provide clauses that control the treatment of nonconformities found during inspection and the treatment of lots resubmitted after initial non-acceptance. Furthermore, the AQL indexed systems contain built-in switching rules (from 'normal' to 'tightened' or to 'reduced' inspection) to adjust the sampling plan in the event of deterioration or improvement in quality. Use of these basic reference standards can save much time often wasted in subjective discussion, and reduce the large areas of

discretion often contained in non-standard sampling schemes that have only limited value, particularly for international trade.

More notes on the practical and economic advantages of using the above Standards are given in 6.1.

6 Some general considerations influencing a selection

6.1 Practical and economic advantages of using the ISO standard sampling plans

Sampling involves risk and quite naturally all parties concerned will attempt to minimize their share. Theoretically these risks are functions of the sampling plan and the quality level specified, without relation to the industry or the product. In practice these risks can be reduced by controlling the production process and improving the level of quality.

These risks cannot be eliminated completely, but they can be precisely calculated and economically assessed by the use of modern statistical techniques. Consequently, it is of benefit to all parties that statistically sound acceptance criteria be specified in product/process specifications and that, wherever possible, the generally applicable basic reference Standards on sampling, such as ISO 2859 and ISO 3951, be utilized.

Generally speaking, in arriving at the optimum performance of an acceptance sampling plan or scheme, prevention costs should be balanced against the probabilities of failure in service. Providing that various assumptions can be made with regard to the sample size to lot size ratio (n/N) and to the appropriate distribution theory, it is a relatively straightforward matter to formulate sampling plans from statistical theory. It should be noted that, while ISO 3951 is only applicable to a product characteristic that has a normal distribution, ISO 2859 is not dependent on the distributional shape of the product characteristic.

It is a more difficult matter to establish practical sampling schemes or Standards that take account of the many and varied situations met in practice to such an extent that they are likely to be adopted for general use by industry world-wide, as is the case with the established AQL indexed procedures given in ISO 2859 and ISO 3951. There are undeniable advantages in having relatively few standard schemes, as this leads to greater uniformity of action and simplifies the administrative procedures across organizational and national boundaries.

The motivation for acceptance sampling is primarily economic: inspection of a sample from a lot is the (usually small) price paid to achieve desirable quality in the accepted lots. This quality is achieved by two pressures, i.e. the purely statistical pressure of different probabilities of acceptance of good and bad quality lots and, secondly, when sequences of lots are purchased, the commercial pressure of frequent non-acceptance of lots and the switch to tightened inspection when quality is poor.

The problem associated with acceptance sampling inspection relates to defining unambiguously the criteria used to judge discrete individual items supplied in quantity, the criterion for acceptance of the lot, the quality level expected from the manufacturing process, the discrimination afforded by the plans and the rules to be followed when a lot is not accepted. Above all, however, it is necessary to design the sampling scheme so that it may be invoked easily in a purchasing contract. The plans in the set of related ISO Standards discussed in 5 enable this to be done efficiently.

6.2 Long and short production runs

ISO 2859-1, ISO 2859-3, ISO 8422, ISO 3951 and ISO 8423 are all intended primarily to be used for a continuing series of lots of sufficient duration to allow the switching rules to be applied. This implies a 'long' production run.

The Limiting Quality (LQ) plans of ISO 2859-2 can be used where the switching rules of ISO 2859-1 are not applicable. They are primarily intended for use with single lots or lots of an 'isolated nature'. By implication this embraces a 'short' series of inspection lots - or a 'short' production run.

ISO 8422 and ISO 8423 can provide sequential plans which match the other Standards and in many cases are thus similarly applicable to long or short runs.

In order for a production run to qualify as 'long', one criterion is clearly that the switching rules have a reasonable chance of coming into effect if "the quality is unsatisfactory". It is equally clear that this alone raises a number of supplementary issues (as indicated by the quotation marks) depending on the requirements and circumstances prevailing in each case considered. It is impossible to stipulate simply and precisely what constitutes a short run (number of lots) in the context of sampling inspection.

In the absence of any other guide, or evidence, on which to base a judgement, anything up to 10 consecutive inspection lots should be considered as a 'short run' and the plans in ISO 2859-2 should be used. However, lots should not be subdivided arbitrarily in order to create a 'long run' artificially. To do so simply introduces other disadvantages. It is always preferable to have large homogeneous lots because they allow a smaller sample size to lot size ratio, and provide better representation by the sample, sharper discrimination and more economical inspection.

In a long production run there will be continuity and stability, so production will settle down to a long term stable process average. Nevertheless, the quality of individual lots will vary about this process average. On the other hand, at the start of production, after a significant break or change in production, or for a short production run, the lot quality may well be somewhat different and more variable, even markedly so. The practical factor to consider is whether there is evidence that a stable process average has been established and exists.

6.3 Nonconformity and nonconforming item

6.3.1 Failure to conform

For the purpose of ISO 2859 and ISO 8422, any failure to conform with a specified characteristic, dimension, attribute or performance requirement represents a nonconformity. A nonconforming item may have one or more nonconformities.

For example, suppose that a ball point pen fails to write. The failure to write is a nonconformity; the pen is nonconforming. The same pen could also have failed to meet its specification in a number of other ways, e.g. colour, dimensions, etc. Though it exhibited several nonconformities it would be counted as one nonconforming item.