

Sampling procedures for inspection by attributes

Part 1. Specification for sampling plans indexed by acceptable quality level (AQL) for lot-by-lot inspection

Règles d'échantillonnage pour les contrôles par attributs
Partie 1. Plans d'échantillonnage pour les contrôles lot par lot indexés d'après le niveau de qualité acceptable (NQA) — Spécifications

Annahmestichprobenprüfung anhand der Anzahl fehlerhafter Einheiten oder Fehler (Attributprüfung)
Teil 1. Nach der annehmbaren Qualitätsgrenzlage (AQL) geordnete Stichprobenanweisungen für die Prüfung einer Serie von Losen

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Quality, Management and Statistics Standards Policy Committee (QMS/-) to Technical Committee QMS/15, upon which the following bodies were represented:

Clay Pipe Development Association Limited
Institute of Quality Assurance
Ministry of Defence
Royal Statistical Society

This British Standard, having been prepared under the direction of the Quality, Management and Statistics Standards Policy Committee, was published under the authority of the Standards Board and comes into effect on 31 May 1991

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First published in March 1972
Second edition May 1991

The following BSI references relate to the work on this standard:
Committee reference QMS/15
Draft for comment 85/62983 DC

ISBN 0 580 19573 2

Amendments issued since publication

Amd. No.	Date	Text affected

Amendment No. 1
published and effective from 15 February 1994
to BS 6001 : Part 1 : 1991

Sampling procedures for inspection by attributes
Part 1. Specification for sampling plans indexed by acceptable
quality level (AQL) for lot-by-lot inspection

NOTE. This amendment implements Technical Corrigendum 1 to
ISO 2859-1 : 1989.

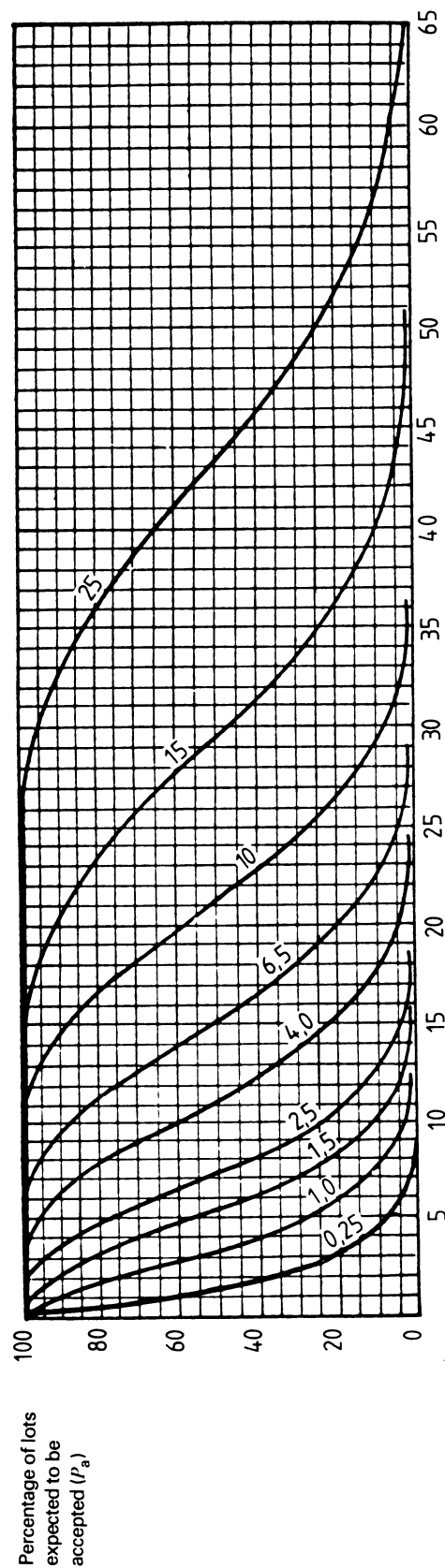
Revised text

Chart H. Operating characteristic curves for single sampling plans

Delete the existing Chart H and substitute the attached new Chart H.
The curve furthest to the left has been renumbered '0,25'. The numbers on the
horizontal axis have been moved one place to the right.

AMD 8026/February 1994

Chart H — Operating characteristic curves for single sampling plans
(Curves for double and multiple sampling are matched as closely as practicable)



Amendment No. 2
published and effective from 15 July 1994
to BS 6001 : Part 1 : 1991

Sampling procedures for inspection by attributes
Part 1. Specification for sampling plans indexed by acceptable
quality level (AQL) for lot-by-lot inspection

Deletions

Contents

Under 'Tables' delete the entries for tables Z1 and Z2.

Delete 'National appendix Z Sequential sampling'.

AMD 8223/July 1994

National foreword

Delete paragraph 5 beginning 'This Part of BS 6001 contains national appendix Z.'.

In paragraph 6, at the end of the list of the various Parts of BS 6001 insert the following.

'Part 4 Specification for sequential sampling plans'

AMD 8223/July 1994

National appendix Z

Delete national appendix Z including tables Z1 and Z2.

AMD 8223/July 1994

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National foreword

This Part of BS 6001, having been prepared under the direction of the Quality, Management and Statistics Standards Policy Committee, supersedes BS 6001 : Part 1 : 1972, which is withdrawn.

This revision is identical with 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' published by the International Organization for Standardization (ISO). It follows the principles and procedures that were given in the 1972 edition, the acceptance criteria remaining technically unchanged throughout the tables, except for minor typographical corrections.

Principal changes that have been made are as follows.

The terminology has been brought up-to-date. In particular 'percent nonconforming' has replaced 'percent defective' and 'nonconformity' has replaced 'defect', primarily to take account of product liability considerations. Also, 'Responsible Authority' has been defined to maintain the neutrality of this standard irrespective of whether it is being invoked or applied by either a first, second or third party. In addition, a new figure has been introduced to illustrate the operation of the switching rules between normal, reduced, tightened and discontinued inspection together with an improved rule for the discontinuation of inspection. Recalculated, much more accurate values for the points on the operating characteristic curves are now given in table X (regrettably there are still some errors in the ISO text. See below).

This Part of BS 6001 contains national appendix Z. This appendix gives sequential sampling plans that can be used (for AQLs of 10.0 or less) instead of the single, double or multiple sampling plans, given in this standard. When sequential sampling plans are used, a smaller average sample size is inspected, but more administrative control is required. If apparatus for semi-automatic use is available, automated sequential sampling offers an opportunity for increased efficiency and economy, particularly when destructive tests are performed. The international standard does not contain sequential sampling plans, but the previous edition of this British Standard did contain them and many users found them to be very useful.

BS 6001 is published in the following Parts.

- Part 1 Specification for sampling plans indexed by acceptable quality level (AQL) for lot-by-lot inspection
- Part 2 Specification for sampling plans indexed by limiting quality (LQ) for isolated lot inspection
- Part 3 Specification for skip-lot procedures

It is envisaged that Part 0 will be published, identical to ISO 2859-0, which is in preparation.

Cross-reference

International standard	Corresponding British Standard
ISO 3534 : 1977	BS 5532 Statistical terminology Part 1 : 1978 Glossary of terms relating to probability and general terms relating to statistics (Identical)

Textual errors. When adopting the text of the international standard, the textual errors listed below were discovered. They have been marked in the text and have been reported to ISO in a proposal to amend the text of the international standard.

In 3.12 line 2, delete 'quality' and substitute 'quantity'.

In 5.1 paragraph 2, line 6, between 'of' and 'AQL' insert 'the'.

In 11.1.4 line 2, delete 'per 100 units'.

In 12.1 line 4, delete 'a given process quality' and substitute 'a range of levels of process quality'.

In table X the correct values are as follows.

Table	P_a	AQL	Present value	Correct value
X-C-1	99,0	40	37,5	35,7
X-E-1	99,0	4,0	1,15	1,14
X-F-1	90,0	6,5 %	9,03	9,02
X-F-1	50,0	15	30,3	38,3
X-H-1	1,0	0,25 %	8,00	8,80
X-H-1	1,0	10 % (tightened)	31,7	31,6
X-M-1	90,0	0,040	0,033 5	0,033 4
X-R-1	95,0	0,25	0,309	0,308
X-R-1	95,0	0,40 (tightened)	0,304	0,384
X-R-1	50,0	0,065	0,181	0,184
X-R-1	1,0	0,25	1,02	1,01

Furthermore, although not an error, feedback from consultants serving UK industry has revealed that the use of the arrows in tables II-A, II-B, II-C, III-A, III-B, III-C, IV-A, IV-B and IV-C is often misunderstood in that the original sample size is used in conjunction with the new acceptance/rejection criteria indicated by the arrow. Therefore, attention is drawn to the second and third sentences in subclause 10.3: 'When no sampling plan is available for a given combination of AQL and sample size code letter, the tables direct the user to a different letter. The sample size to be used is given by the new sample size code letter, not by the original letter.'

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

Sampling procedures for inspection by attributes —

Part 1:

Sampling plans indexed by acceptable quality level (AQL) for lot-by-lot inspection

1 Scope

This part of ISO 2859 specifies sampling plans and procedures for inspection by attributes of discrete items. It is indexed in terms of the Acceptable Quality Level (AQL).

Its purpose is to induce a supplier through the economic and psychological pressure of lot non-acceptance to maintain a process average 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 poor lot.

This part of ISO 2859 is not intended as a procedure for estimating lot quality or for segregating lots.

Sampling plans designated in this part of ISO 2859 are applicable, but not limited, to inspection of

- a) end items;
- b) components and raw materials;
- c) operations;
- d) materials in process;
- e) supplies in storage;
- f) maintenance operations;
- g) data or records;
- h) administrative procedures.

These plans are intended primarily to be used for a continuing series of lots sufficient to allow the switching rules to be applied, which provide for

- an automatic protection to the consumer, should a deterioration in quality be detected (by a switch to tightened inspection or discontinuance of inspection);
- an incentive to reduce inspection costs (at the discretion of the responsible authority) should consistently good quality be achieved (by a switch to reduced inspection).

These plans 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 (see 12.6). In that case, the user is also referred to the sampling plans indexed by limiting quality (LQ) given in ISO 2859-2.

2 Normative reference

The following standard contains provisions which, through reference in this text, constitute provisions of this part of ISO 2859. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this part of ISO 2859 are encouraged to investigate the possibility of applying the most recent editions of the standard indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 3534 : 1977, *Statistics — Vocabulary and symbols*.

3 Terminology and definitions

The terminology and definitions used in this International Standard are in accordance with ISO 3534.

3.1 defect: A departure of a quality characteristic that results in a product, process or service not satisfying its intended normal usage requirements.

3.2 nonconformity: A departure of a quality characteristic that results in a product, process or service not meeting a specified requirement. Nonconformities will generally be classified by their degree of seriousness such as:

Class A — Those nonconformities of a type considered to be of the highest concern for the product or service. In acceptance sampling, such types of nonconformity will be assigned very small AQL values.

Class B — Those nonconformities of a type considered to have the next lower degree of concern. Therefore these can be assigned a larger AQL value than those in class A and smaller than in class C, if a third class exists, etc.

NOTES

- 1 The term defect is reserved for nonconformities that result in a product or service not satisfying its intended usage requirements.
- 2 The user is cautioned that adding characteristics and classes of nonconformities will generally affect the overall probability of acceptance of the product.
- 3 The number of classes, the assignment into a class, and the choice of AQL for each class, should be appropriate to the quality requirements of the specific situation.

3.3 nonconforming unit: A unit of product or service containing at least one nonconformity. Nonconforming units will generally be classified by their degree of seriousness such as :

Class A — A unit which contains one or more nonconformities of class A and may also contain nonconformities of class B and/or class C.

Class B — A unit which contains one or more nonconformities of class B and may also contain nonconformities of class C, but contains no nonconformity of class A.

3.4 percent nonconforming: The percent nonconforming of any given quantity of units of product is 100 times the number of nonconforming units divided by the total number of units of product, i.e.

$$\text{Percent nonconforming} = \frac{\text{Number of nonconforming units}}{\text{Total number of units}} \times 100$$

NOTE — Sampling plans for inspection by attributes are given in terms of the percentage or proportion of units of product in a lot or batch that depart from some requirement, or the number of such departures. Throughout this part of ISO 2859 the terms "percent nonconforming units" (3.4) or "numbers of nonconformities per 100 units" (3.5) are used since these terms are likely to constitute the most widely used criteria for sampling.

3.5 nonconformities per 100 units: The number of nonconformities per 100 units of any given quantity or units of product is 100 times the number of nonconformities contained therein (one or more nonconformities being possible in any unit of product) divided by the total number of units of product, i.e.

$$\text{Nonconformities per 100 units} = \frac{\text{Number of nonconformities}}{\text{Total number of units}} \times 100$$

3.6 acceptable quality level (AQL): When a continuous series of lots is considered, the quality level which for the purposes of sampling inspection is the limit of a satisfactory process average. (See clause 5.)

3.7 sampling plan: A specific plan which indicates the number of units of product from each lot which are to be inspected (sample size or series of sample sizes) and the associated criteria for determining the acceptability of the lot (acceptance and rejection numbers).

NOTE — For the purposes of this part of ISO 2859, a distinction should be made between the terms *sampling plan* (3.7), *sampling scheme* (3.8) and *sampling system* (3.9).

3.8 sampling scheme: A combination of sampling plans with switching procedures (see 9.3).

3.9 sampling system: A collection of sampling plans or schemes. This part of ISO 2859 is a sampling system indexed by lot-size ranges, inspection levels and AQLs. A sampling system for LQ plans is given in ISO 2859-2.

3.10 responsible authority: A generic term used to maintain the neutrality of this part of ISO 2859 (primarily for specification purposes), irrespective of whether it is being invoked or applied by the first, second or third party.

NOTES

- 1 The responsible authority may be:
 - a) the quality department within a supplier's organization (first party);
 - b) the purchaser or procurement organization (second party);
 - c) an independent verification or certification authority (third party);
 - d) any of a), b) or c), differing according to function (see note 2) as described in a written agreement between two of the parties, for example a document between supplier and purchaser.
- 2 The duties and functions of a responsible authority are outlined in this part of ISO 2859 (see 5.2, 6.2, clause 7, 9.1, 9.3.3, 9.4, 10.1, 10.3).

3.11 inspection: The process of measuring, examining, testing, gauging or otherwise comparing the unit of product (see 3.14) with the applicable requirements.

3.12 original inspection: The first inspection of a particular quality of product as distinguished from the inspection of product which has been resubmitted after prior non-acceptance.

3.13 inspection by attributes: Inspection whereby either the unit of product is classified simply as conforming or nonconforming, or the number of nonconformities in the unit of product is counted, with respect to a given requirement or set of requirements.

3.14 unit of product: The item inspected in order to determine its classification as conforming or nonconforming or to count the number of nonconformities. It may be a single article, a pair, a set, a length, an area, an operation or a volume. It may be a component of an end product or the end product itself. The unit of product may or may not be the same as the unit of purchase, supply, production, or shipment.

3.15 lot: A collection of units of product from which a sample shall be drawn and inspected to determine conformance with the acceptability criteria, and which may differ from a collection of units designated as a lot for other purposes (for example, production, shipment, etc.) (see clause 6).

NOTE — The term "batch" is sometimes used.

3.16 lot size: The number of units of product in a lot.

3.17 sample: A sample consists of one or more units of product drawn from a lot, the units of the sample being selected at random without regard to their quality. The number of units of product in the sample is the sample size.

*See national foreword for details of textual error.

3.18 limiting quality (LQ): When a lot is considered in isolation, a quality level which, for the purposes of sampling inspection, is limited to a low probability of acceptance.

NOTE — For a particular sampling system (see ISO 2859-2), the probability of acceptance will lie within a defined range.

4 Expression of nonconformity

The extent of nonconformity shall be expressed either in terms of percent nonconforming (see 3.4) or in terms of nonconformities per 100 units (see 3.5). The tables assume that nonconformities occur randomly and with statistical independence. There may be good reasons for suspecting that one nonconformity could be caused by a condition also likely to cause others. If so, it may be better to consider the units just as conforming or not and ignore multiple nonconformities.

5 Acceptable quality level (AQL)

* 5.1 Use and application

The AQL, together with the sample size code letter (see 10.2), is used for indexing the sampling plans and schemes provided in this part of ISO 2859.

When a specific value of the AQL is designated for a certain nonconformity or group of nonconformities, it indicates that the sampling scheme will accept the great majority of the lots submitted, provided the quality level (percent nonconforming or nonconformities per 100 units) in these lots is no greater than the designated value of AQL. Thus, the AQL is a designated value of percent nonconforming (or nonconformities per 100 units) that will be accepted most of the time by the sampling scheme to be used. The sampling plans provided are so arranged that the probability of acceptance at the designated AQL value depends upon the sample size for a given AQL, being generally higher for large samples than for small ones.

The AQL is a parameter of the sampling scheme and should not be confused with the process average which describes the operating level of the manufacturing process. It is expected that the process average will be less than or equal to the AQL to avoid excessive rejections under this system.

CAUTION — The designation of an AQL shall not imply that the supplier has the right knowingly to supply any nonconforming unit of product.

5.2 Specifying AQLs

The AQL to be used shall be designated in the contract or by, or according to, the responsible authority. Different AQLs may be designated for groups of nonconformities considered collectively or for individual nonconformities as defined in 3.2. The classification into groups should be appropriate to the quality requirements of the specific situation. An AQL for a group of nonconformities may be designated in addition to AQLs for individual nonconformities, or subgroups, within that group.

AQL values of 10 or less may be expressed either in percent nonconforming or in nonconformities per 100 units; those over 10 shall be expressed in nonconformities per 100 units only.

5.3 Preferred AQLs

The values of AQLs given in the tables are known as preferred AQLs. If, for any product, an AQL is designated other than a preferred AQL, these tables are not applicable.

6 Submission of product for sampling

6.1 Formation of lots

The product shall be assembled into identifiable lots, sub-lots, or in such other manner as may be laid down (see 6.2). Each lot shall, as far as is practicable, consist of units of product of a single type, grade, class, size and composition, manufactured under essentially the same conditions and at essentially the same time.

6.2 Presentation of lots

The formation of the lots, the lot size and the manner in which each lot shall be presented and identified by the supplier shall be designated or approved by, or according to, the responsible authority. As necessary, the supplier shall provide adequate and suitable storage space for each lot, equipment needed for proper identification and presentation, and personnel for all handling of product required for drawing of samples.

7 Acceptance and non-acceptance

7.1 Acceptability of lots

Acceptability of a lot shall be determined by the use of a sampling plan or plans associated with the designated AQL or AQLs.

The term “non-acceptance” is used in this context for “rejection” when it refers to the result of following the procedure. Forms of the term “reject” are retained when they refer to actions the consumer may take, as in “rejection number.”

The responsible authority shall decide how lots which are not accepted will be disposed of. Such lots may be scrapped, sorted (with or without nonconforming units being replaced), reworked, re-evaluated against more specific usability criteria, held for additional information, etc.

7.2 Nonconforming units

The right is reserved to reject any unit of product found nonconforming during inspection whether that unit of product forms a part of a sample or not, and even if the lot as a whole is accepted. Rejected units may be repaired or corrected, and resubmitted for inspection with the approval of, and in the manner specified by, the responsible authority.

*See national foreword for details of textual error.

7.3 Special reservation for designated nonconformities

Since most acceptance sampling involves evaluation of more than one quality characteristic and since these may differ in importance in terms of quality and/or economic effects, it is often desirable to classify the types of nonconformity according to agreed classes as defined in 3.2. Specific assignment of types of nonconformities to each class depends on agreement on specific sampling applications. In general, the function of such classification is to permit the use of a set of sampling plans having a common sample size, but different acceptance numbers, for each class having a different AQL, such as in tables II, III and IV.

At the discretion of the responsible authority, every unit of the lot may be required to be inspected for designated classes of nonconformities. The right is reserved to inspect every unit submitted for designated nonconformities and to reject the lot immediately a nonconformity of this class is found. The right is also reserved to sample, for specified classes of nonconformities, every lot submitted by the supplier and to reject any lot if a sample drawn from it is found to contain one or more of these nonconformities.

7.4 Resubmitted lots

All parties shall be immediately notified if a lot is found unacceptable. Such lots shall not be resubmitted for reinspection until all units are re-examined or retested and the supplier is satisfied that all nonconforming units have been removed or nonconformities corrected. The responsible authority shall determine whether normal or tightened inspection shall be used on reinspection and whether reinspection shall include all types or classes of nonconformities or only the particular types or classes of nonconformities which caused initial rejection.

8 Drawing of samples

8.1 Representative or stratified sampling

When appropriate, the number of units in the sample shall be selected in proportion to the size of sub-lots or strata of the lot, identified by some rational criterion. When stratified sampling is used, the units from each stratum of the lot shall be selected at random.

8.2 Time for drawing the samples

Samples may be drawn after all the units comprising the lot have been assembled, or during production of the lot. In either case, the samples shall be selected at random.

8.3 Double or multiple sampling

When double or multiple sampling is to be used, each sample shall be selected from the entire lot.

9 Normal, tightened and reduced inspection

9.1 Start of inspection

Normal inspection shall be carried out at the start of inspection, unless otherwise directed by the responsible authority.

9.2 Continuation of inspection

Normal, tightened or reduced inspection shall continue unchanged on successive lots, except where the switching procedures (see 9.3) require change. The switching procedures shall be applied to each class of nonconformities or nonconforming units independently.

9.3 Switching rules and procedures (see figure 1)

9.3.1 Normal to tightened

When normal inspection is being carried out, tightened inspection shall be put into operation when two out of five or less consecutive lots have been non-acceptable on original inspection (that is, ignoring resubmitted lots or batches for this procedure).

9.3.2 Tightened to normal

When tightened inspection is being carried out, normal inspection shall be reverted to when five consecutive lots have been considered acceptable on original inspection.

9.3.3 Normal to reduced

When normal inspection is being carried out, reduced inspection shall be put into operation provided that all of the following conditions are satisfied:

- a) the preceding 10 lots (or more, as indicated by the note to table VIII) have been submitted to normal inspection and all have been accepted on original inspection; and
- b) the total number of nonconforming units (or nonconformities) in the samples from the preceding 10 lots (or such other number as was used for condition a) above) is equal to or less than the applicable limit number given in table VIII. If a double or multiple sample is in use, all samples inspected should be included, not "first" samples only; and
- c) production is at a steady rate; and
- d) reduced inspection is considered desirable by the responsible authority.

9.3.4 Reduced to normal

When reduced inspection is being carried out, normal inspection shall be reverted to if any of the following occur on original inspection:

- a) a lot is not accepted; or

- b) a lot is considered acceptable under the procedures for reduced inspection given in 11.1.4; or
- c) production becomes irregular or delayed; or
- d) other conditions warrant that normal inspection shall be reverted to.

9.4 Discontinuation of inspection

If the cumulative number of lots not accepted in a sequence of consecutive lots on original tightened inspection reaches 5, the acceptance procedures of this part of ISO 2859 shall be discontinued. Inspection under the provisions of this part of ISO 2859 shall not be resumed until action has been taken by the supplier to improve the quality of the submitted product or service. The responsible authority shall agree that this action is likely to be effective. Tightened inspection shall then be used as if 9.3.1 had been invoked.

10 Sampling plans

10.1 Inspection level

The inspection level required for any particular application shall be prescribed by the responsible authority. This allows the authority to require greater discrimination for some purposes and less for others. At each inspection level, the switching rules shall operate to require normal, tightened and reduced inspection, as specified in clause 9. The choice of inspection level is quite separate from these three forms of inspection. Three inspection levels, I, II, and III, are given in table I for general use. Unless otherwise specified, level II shall be used. Level I may be used when less discrimination is needed or level III when greater discrimination is required. Four additional special levels, S-1, S-2, S-3 and S-4 are also given in table I and may be used where relatively small sample sizes are necessary and large sampling risks can or shall be tolerated.

In the designation of inspection levels S-1 to S-4, care shall be exercised to avoid AQLs inconsistent with these inspection levels. In other words, the purpose of the special inspection levels is to keep samples small where necessary. For instance, the code letters under S-1 go no further than D, equivalent to a single sample of size 8, but it is of no use to specify S-1, if the AQL is 0,1 % for which the minimum sample size is 125.

The amount of information about the quality of a lot gained from examining samples drawn from the lot depends upon the absolute size of the samples, not upon the percentage of the lot, provided the lot is large relative to the sample that is examined. In spite of this, there are three reasons for varying the sample size with the lot size:

- a) when there is more at stake, it is more important to make the correct decision;
- b) with a large lot, a sample size can be afforded that would be uneconomic for a small lot;
- c) truly random selection is relatively more time consuming if the sample is too small a proportion of the lot.

10.2 Sample size code letters

Sample sizes are designated by code letters. Table I shall be used to find the applicable code letter for the particular lot size and the prescribed inspection level.

10.3 Obtaining a sampling plan

The AQL and the sample size code letter shall be used to obtain the sampling plan from tables II, III or IV. When no sampling plan is available for a given combination of AQL and sample size code letter, the tables direct the user to a different letter. The sample size to be used is given by the new sample size code letter, not by the original letter. If this procedure leads to different sample sizes for different classes of nonconformities, the sample size code letter corresponding to the largest sample size derived may be used for all classes of nonconformities, when designated or approved by the responsible authority. As an alternative to a single sampling plan with an acceptance number of 0, the plan with an acceptance number of 1 with its correspondingly larger sample size for a designated AQL (where available) may be used, when designated or approved by the responsible authority.

10.4 Types of sampling plans

Three types of sampling plans, — single, double and multiple —, are given in tables II, III and IV, respectively. When several types of plans are available for a given AQL and sample size code letter, any one may be used. A decision as to type of plan, either single, double, or multiple, when available for a given AQL and sample size code letter, shall usually be based upon the comparison between the administrative difficulty and the average sample sizes of the available plans. For the sampling plans given in this part of ISO 2859, the average sample size of multiple plans is less than for double (except in the case corresponding to single acceptance number 1), and both of these are usually less than the single sample size (see table IX). Usually, the administrative difficulty for single sampling and the cost per unit of the sample are less than for double or multiple.

11 Determination of acceptability

11.1 Percent nonconforming inspection

To determine acceptability of a lot under percent nonconforming inspection, the applicable sampling plan shall be used in accordance with 11.1.1, 11.1.2, 11.1.3 and 11.1.4.

11.1.1 Single sampling plan

The number of sample units inspected shall be equal to the sample size given by the plan. If the number of nonconforming units found in the sample is equal to or less than the acceptance number, the lot shall be considered acceptable. If the number of nonconforming units is equal to or greater than the rejection number, the lot shall be considered not acceptable.

11.1.2 Double sampling plan

The number of sample units first inspected shall be equal to the first sample size given by the plan. If the number of nonconforming units found in the first sample is equal to or less than the first acceptance number, the lot shall be considered acceptable. If the number of nonconforming units found in the first sample is equal to or greater than the first rejection number, the lot shall be considered not acceptable.

If the number of nonconforming units found in the first sample is between the first acceptance and rejection numbers, a second sample of the size given by the plan shall be inspected. The number of nonconforming units found in the first and second samples shall be accumulated. If the cumulative number of nonconforming units is equal to or less than the second acceptance number, the lot shall be considered acceptable. If the cumulative number of nonconforming units is equal to or greater than the second rejection number, the lot shall be considered not acceptable.

11.1.3 Multiple sampling plan σ

In multiple sampling, the procedure shall be similar to that specified in 11.1.2. In this part of ISO 2859, there are seven stages so that a decision will be reached by the seventh stage.

11.1.4 Special procedure for reduced inspection

In reduced inspection, the sample may contain a number of nonconforming units or nonconformities per 100 units between the acceptance and rejection numbers. In these circumstances, the lot shall be considered acceptable, but normal inspection shall be reinstated starting with the next lot [see 9.3.4 b)].

11.2 Nonconformities per 100 units inspection

In order to determine the acceptability of a lot in a nonconformities per 100 units inspection, the procedure specified for percent nonconforming inspection (see 11.1) shall be used, except that the term "nonconformities" shall be substituted for "nonconforming units".

12 Further information

12.1 Operating characteristic (OC) curves

The operating characteristic curves for normal and tightened inspection, shown in table X, indicate the percentage of lots or batches which may be expected to be accepted under the various sampling plans for a given process quality. The operating characteristic curve for unqualified acceptance in a reduced inspection (i.e. when the number of nonconforming units is less than or equal to the acceptance number) can be found by using the AQL index of the normal plan with the sample size(s) and acceptance number(s) of the reduced plan. The curves shown are for single sampling; curves for double and multiple sampling are matched as closely as practicable. The OC curves shown for AQLs greater than 10 are based on the Poisson distribution and are applicable for nonconformities

per 100 units inspection; those for AQLs of 10 or less and sample sizes of 80 or less are based on the binomial distribution and are applicable for percent nonconforming inspection; those for AQLs of 10 or less and sample sizes larger than 80 are based on the Poisson distribution and are applicable either for nonconformities per 100 units inspection or for percent nonconforming inspection (the Poisson distribution being an adequate approximation to the binomial distribution under these conditions).

Tabulated values, corresponding to selected values of probabilities of acceptance, P_a , expressed in percentage terms, are given for each of the curves shown, and, in addition, for tightened inspection, and for nonconformities per 100 units for AQLs of 10 or less and sample sizes of 80 or less.

12.2 Process average

The process average can be estimated by the average percent nonconforming or average number of nonconformities per 100 units (whichever is applicable) found in the samples of product submitted by the supplier for original inspection, provided that inspection was not curtailed. When double or multiple sampling is used, only first sample results shall be included in the process average estimation.

12.3 Average outgoing quality (AOQ)

The AOQ is the average quality of outgoing product, including all accepted lots, plus all lots which are not accepted, after such lots have been effectively 100 % inspected and all nonconforming units replaced by conforming units.

12.4 Average outgoing quality limit (AOQL)

The AOQL is the maximum of the AOQs for all possible qualities submitted for a given acceptance sampling plan. Approximate AOQL values are given in table V-A for each of the single sampling plans for normal inspection and in table V-B for each of the single sampling plans for tightened inspection.

12.5 Average sample size curves

Average sample size curves for double and multiple sampling, as compared with the single sampling plan for each acceptance number, are given in table IX. These curves show the average sample sizes which may be expected to occur under the various sampling plans for given levels of process quality. The curves assume that the inspection is not curtailed.

12.6 Limiting quality protection

12.6.1 Use of individual plans

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

*See national foreword for details of textual error.

Occasionally, specific individual plans are selected from this part of ISO 2859 and used without the switching rules. For example, a purchaser may be using the plans for verification purposes only. This is not the intended application of the system given in this part of ISO 2859 and its use in this way should not be referred to as "inspection in compliance with ISO 2859-1". When used in this way, this part of ISO 2859 simply represents a repository for a collection of individual plans indexed by AQL. The operating characteristic curves and other measures of a plan so chosen shall be assessed individually for a plan from the tables provided.

12.6.2 Limiting quality tables

If the lot or batch is of an isolated nature, it may be desirable to limit the selection of sampling plans to those, associated with a designated AQL value, that provide not less than a specified limiting quality protection. Sampling plans for this purpose can be selected by choosing a limiting quality (LQ) and a

consumer's risk to be associated with it. For a definition of limiting quality, see 3.18.

Tables VI and VII give percent nonconforming levels for which the probabilities of lot acceptance under various sampling plans are 10 % and 5 %, respectively. For individual lots with percents nonconforming or nonconformities per 100 units equal to the specified limiting quality values, the probabilities of lot acceptance are less than 10 % in the case of plans listed in table VI and less than 5 % in the case of plans listed in table VII. Where there is reason for avoiding more than a limiting percentage of nonconforming units (or nonconformities) in a lot, tables VI and VII may be useful for fixing minimum sample sizes to be associated with the AQL and inspection level specified for the inspection of a series of lots. For example, if an LQ of 5 % is desired for individual lots with an associated P_a of 10 % or less, then if an AQL of 1 is designated for inspection of a series of lots, table VI indicates that the minimum sample size shall be given by sample size code letter L. ISO 2859-2 gives further details of the method of sampling for lots in isolation.

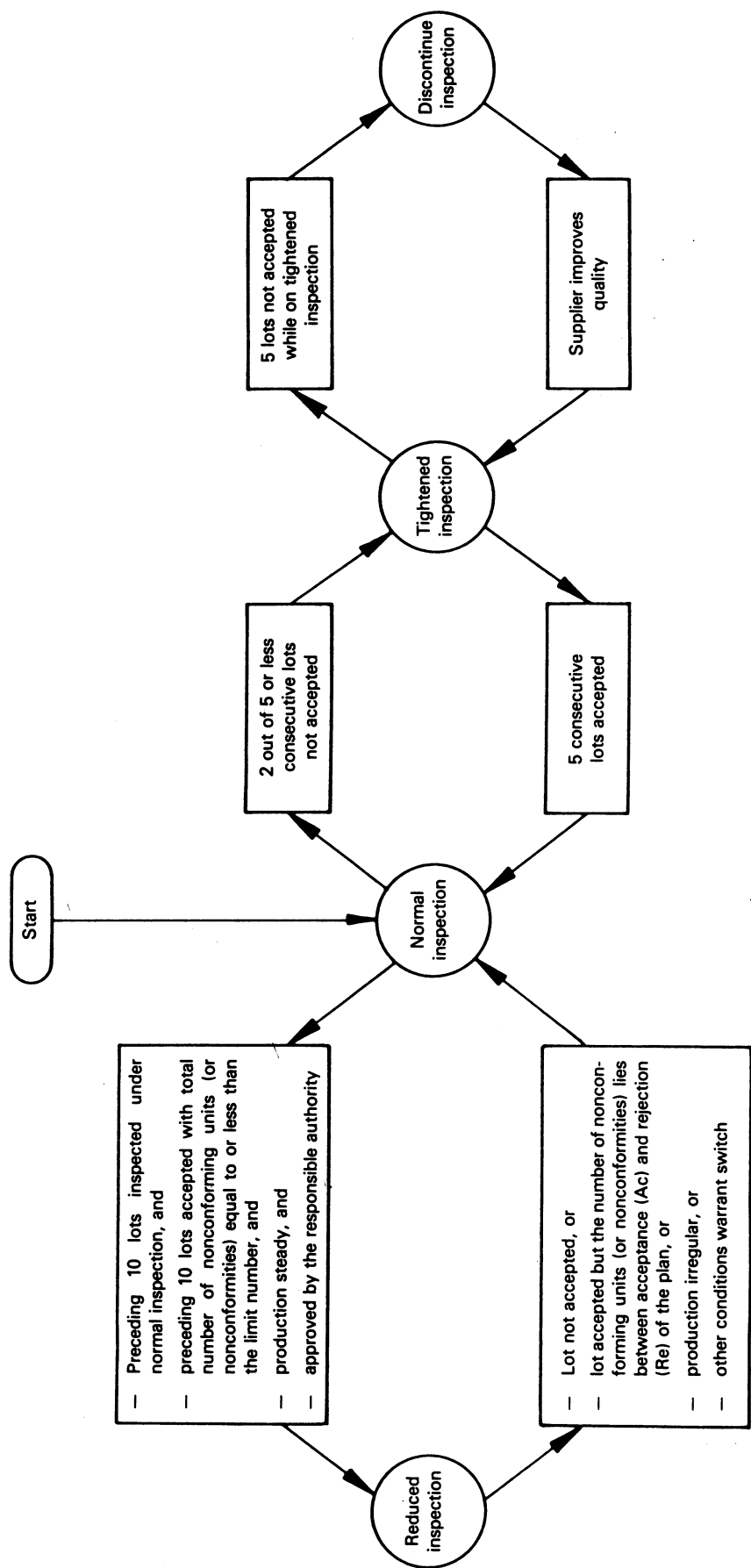


Figure 1 — Outline of the switching rules (see 9.3)

TABLES

Table I — Sample size code letters (see 10.1 and 10.2)

Lot or batch size	Special inspection levels				General inspection levels		
	S-1	S-2	S-3	S-4	I	II	III
2 to 8	A	A	A	A	A	A	B
9 to 15	A	A	A	A	A	B	C
16 to 25	A	A	B	B	B	C	D
26 to 50	A	B	B	C	C	D	E
51 to 90	B	B	C	C	C	E	F
91 to 150	B	B	C	D	D	F	G
151 to 280	B	C	D	E	E	G	H
281 to 500	B	C	D	E	F	H	J
501 to 1 200	C	C	E	F	G	J	K
1 201 to 3 200	C	D	E	G	H	K	L
3 201 to 10 000	C	D	F	G	J	L	M
10 001 to 35 000	C	D	F	H	K	M	N
35 001 to 150 000	D	E	G	J	L	N	P
150 001 to 500 000	D	E	G	J	M	P	Q
500 001 and over	D	E	H	K	N	Q	R

Table II-A — Single sampling plans for normal inspection (Master table) (see 10.3 and 10.4)

Sample size letter		Sample size		Acceptable quality levels (normal inspection)																								
				0,010	0,015	0,025	0,040	0,065	1,0	1,5	2,5	4,0	6,5	10	15	25	40	65	100	150	250	400	650	1 000				
A	2	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re			
	3	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac				
	5	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac				
D	8	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac				
	13	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac				
	20	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac				
G	32	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac				
	50	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac				
	80	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac				
K	125	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac				
	200	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac				
	315	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac				
N	500	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac				
	800	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac				
	1 250	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac				
R	2 000	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac				

↓ = Use first sampling plan below arrow. If sample size equals, or exceeds, lot or batch size, carry out 100 % inspection.

↑ = Use first sampling plan above arrow.

Ac = Acceptance number

Re = Rejection number

SINGLE TIGHTENED

12

↑ = Use first sampling plan above arrow.

Use first sampling plan
 = Acceptance number
 = Rejection number

[illegible]

↑ = Use first sampling plan above arrow.

= If the acceptance number has been exceeded, but the rejection number has not been reached, accept the lot, but revert to normal inspection (see 11.1.4).

Table III-A — Double sampling plans for normal inspection (Master table) (see 10.3 and 10.4)

Acceptable quality levels (normal inspection)																										
Sample size code letter	Sample size	Cumulative sample size	0,010	0,015	0,025	0,040	0,065	1,0	1,5	2,5	4,0	6,5	10	15	25	40	65	100	150	250	400	650	1 000			
			Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re		
A			↓																							
B	First	2	↓																							
	Second	2 4	↓																							
C	First	3	↓																							
	Second	3 6	↓																							
D	First	5	↓																							
	Second	5 10	↓																							
E	First	8	↓																							
	Second	8 16	↓																							
F	First	13	↓																							
	Second	13 26	↓																							
G	First	20	↓																							
	Second	20 40	↓																							
H	First	32	↓																							
	Second	32 64	↓																							
J	First	50	↓																							
	Second	50 100	↓																							
K	First	80	↓																							
	Second	80 160	↓																							
L	First	125	↓																							
	Second	125 250	↓																							
M	First	200	↓																							
	Second	200 400	↓																							
N	First	315	↓																							
	Second	315 630	↓																							
P	First	500	↓																							
	Second	500 1 000	↓																							
Q	First	800	↓																							
	Second	800 1 600	↓																							
R	First	1 250	↓																							
	Second	1 250 2 500	↓																							

↓ = Use first sampling plan below arrow. If sample size equals, or exceeds, lot or batch size, carry out 100 % inspection.

↑ = Use first sampling plan above arrow.

Ac = Acceptance number

Re = Rejection number

• = Use corresponding single sampling plan (or alternatively use double sampling plan below, where available).