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Sampling procedures for inspection by variables —

Part 3:
Double sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection

Règles d'échantillonnage pour les contrôles par mesures —

Partie 3: Plans d'échantillonnage doubles pour le contrôle lot par lot, indexés d'après le niveau de qualité acceptable (NQA)

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 3951-3 was prepared by Technical Committee ISO/TC 69, *Applications of statistical methods*, Subcommittee SC 5, *Acceptance sampling*.

ISO 3951 consists of the following parts, under the general title *Sampling procedures for inspection by variables*:

— *Part 1: Specification for single sampling plans indexed by acceptance quality limit (AQL) for lot-by-lot inspection for a single quality characteristic and a single AQL*

— *Part 2: General specification for single sampling plans indexed by acceptance quality limit (AQL) for lot-by-lot inspection of independent quality characteristics*

— *Part 3: Double sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection*

— *Part 5: Sequential sampling plans indexed by acceptance quality limit (AQL) for inspection by variables (known standard deviation)*

The following part is under preparation:

— *Part 4: Procedures for assessment of declared quality levels*

Introduction

Inspection by variables for percentage nonconforming items, as described in this part of ISO 3951, includes several possible modes, the combination of which leads to a presentation which may appear quite complicated to the user:

a) procedures for unknown process standard deviation (the "s" method), or procedures for where the process standard deviation is originally unknown then estimated with fair precision, or known since the start of inspection (the "σ" method);

b) a single specification limit, or double specification limits with separate, combined or complex control;

c) normal inspection, tightened inspection or reduced inspection;

d) Form k plans and Form p^* plans;

e) a single quality characteristic (the univariate case) or a number of unrelated quality characteristics (the multivariate independent case).

The text has been arranged so that the simpler procedures may be implemented without necessarily understanding the more complicated procedures. The main text of this part of ISO 3951 is confined to the univariate case. The multivariate independent cases are treated separately in Annex A for the "s" method, in Annex B for the "σ" method and in Annex C for combined "s" method and "σ" method procedures. Annex D facilitates the use of the main text of the standard by directing the user to the clauses and tables concerning any univariate situation with which he might be confronted; it only deals with Clauses 16, 17, 21, 22 and 23 and, in every case, it is necessary to have read Clauses 1 to 15 and Clauses 18 to 20 first.

This part of ISO 3951 is complementary to the double sampling plans and procedures of ISO 2859-1. When specified by the responsible authority, it would be valid to reference both ISO 3951-3 and ISO 2859-1 in a product specification, a contract, inspection instructions, or other documents, and the provisions set forth therein shall govern. The "responsible authority" can then be designated in one of these documents.

In all parts of ISO 3951:

— the acronym AQL stands for "acceptance quality limit" rather than "acceptable quality level", in order to more accurately reflect its function;

— procedures are given for the case where the process standard is unknown (the "s" method) and for the case where it may be presumed to be known (the "σ" method);

— the sampling plans have been chosen so that their operating characteristic curves closely match those of the corresponding single sampling plans in ISO 2859-1;

— minimal statistical theory has been given (it being planned ultimately to provide this in a guidance document to sampling procedures for inspection by variables);

— text, charts and tables that are only informative have been consigned to annexes wherever practicable.

In none of the parts have methods been given based on the sample range, now that the availability of computers and calculators with a standard deviation function key is so widespread. Data for acceptance sampling by variables is often substantially more expensive to acquire than data for sampling by attributes, and the "s" method makes more efficient use of these data.

The coverage of ISO 3951-1 is constrained to the case of a single, normally distributed, quality characteristic with a single class of nonconformity, and includes the case of combined control of double specification limits.

ISO 3951-2 provides a more comprehensive treatment of single sampling plans by variables, including procedures for separate and complex control of double specification limits. Procedures are also given for multiple independent quality characteristics and/or multiple AQLs.

ISO 3951-3 provides plans for double sampling by variables, which on average provide substantial savings of inspection effort in comparison with plans for single sampling by variables. The savings are achieved by first selecting from the lot and inspecting a random sample that is typically nearly 40 % smaller than that of the corresponding single sampling plan. If these inspection results satisfy an acceptance criterion, an immediate decision is made to accept the lot without further inspection. Alternatively, if the inspection results satisfy a non-acceptance criterion, an immediate decision not to accept the lot is made without further inspection. Thus, when quality is very good or very poor, the saving in inspection effort can amount to nearly 40 %. Only when the inspection results from the first sample are equivocal is a second random sample, of the same size as the first, selected; the acceptability of the lot is then resolved by combining the results of the first and second samples and determining whether they satisfy a second acceptance criterion.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Sampling procedures for inspection by variables —

Part 3:
Double sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection

1 Scope

This part of ISO 3951 specifies an acceptance sampling system of double sampling schemes for inspection by variables for percent nonconforming. It is indexed in terms of the acceptance quality limit (AQL).

The objectives of the methods laid down in this part of ISO 3951 are to ensure that lots of acceptable quality have a high probability of acceptance and that the probability of non-accepting inferior lots is as high as practicable. This is achieved by means of the switching rules, which provide

— automatic protection to the consumer (by means of a switch to tightened inspection or discontinuation of sampling inspection) should a deterioration in quality be detected, and

— an incentive (at the discretion of the responsible authority) to reduce inspection costs (by means of a switch to a smaller sample size) should consistently good quality be achieved.

In this part of ISO 3951, the acceptability of a lot is implicitly or explicitly determined from an estimate of the percentage of nonconforming items in the process, based on either one or two random samples of items from the lot.

This part of ISO 3951 is primarily designed for use under the following conditions:

a) where the inspection procedure is to be applied to a continuing series of lots of discrete products all supplied by one producer using one production process; if there are different producers or production processes, apply this part of ISO 3951 to each one separately;

b) where the items of product have a single quality characteristic (for multiple quality characteristics, see informative Annexes A, B and C);

c) where the quality characteristic is measurable on a continuous scale;

d) where the measurement error is negligible (i.e. with a standard deviation of no more than 10 % of the corresponding process standard deviation);

e) where production is stable (under statistical control) and the quality characteristic is distributed, at least to a close approximation, according to a normal distribution;

CAUTION — The procedures in this part of ISO 3951 are not suitable for application to lots that have been screened previously for nonconforming items.

f) where the possibility of having to select and inspect a second sample is administratively acceptable;

g) where a contract or standard defines an upper specification limit U, a lower specification limit L or both on the quality characteristic. An item is deemed to conform if its measured quality characteristic x satisfies the appropriate one of the following inequalities:

1) $x \geqslant L$ (i.e. the lower specification limit is not violated);

2) $x \leqslant U$ (i.e. the upper specification limit is not violated);

3) $x \geqslant L$ and $x \leqslant U$ (i.e. neither the lower nor the upper specification limit is violated).

NOTE Inequalities 1) and 2) are called cases with a "single specification limit", and 3) is the case with "double specification limits". For double specification limits, a further distinction is made between combined control, separate control and complex control, as follows:

— combined control is where a single AQL applies to nonconformity beyond both limits;

— separate control is where separate AQLs apply to nonconformity beyond each of the limits;

— complex control is where one AQL applies to nonconformity beyond the limit that is of greater seriousness, and a larger AQL applies to the total nonconformity beyond both limits.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3534-1, *Statistics — Vocabulary and symbols — Part 1: General statistical terms and terms used in probability*

ISO 3534-2:2006, *Statistics — Vocabulary and symbols — Part 2: Applied statistics*

3 Terms and definitions

For the purposes of this part of ISO 3951, the definitions given in ISO 3534-1, ISO 3534-2 and the following apply. References are given in square brackets for definitions that have been re-expressed in the vocabulary of this part of ISO 3951 for the user's convenience.

3.1
inspection by variables
inspection by measuring the magnitude(s) of the characteristic(s) of an item

[ISO 3534-2:2006, definition 4.1.4]

3.2
sampling inspection
inspection of selected items in the group under consideration

[ISO 3534-2:2006, definition 4.1.6]

3.3
acceptance sampling inspection
acceptance inspection where the acceptability is determined by means of sampling inspection

[ISO 3534-2:2006, definition 4.1.8]

3.4
double sampling inspection, double sampling
acceptance sampling inspection based initially on a first sample, of size n_1, which leads to a decision to accept, non-accept, or to inspect a second sample, of size n_2, before taking the decision whether or not to accept

NOTE 1 The decisions are made according to defined rules.

NOTE 2 In this part of ISO 3951, both sample sizes are equal and denoted by n, i.e. $n_1 = n_2 = n$.

3.5
acceptance sampling inspection by variables
acceptance sampling inspection in which the acceptability of the process is determined statistically from measurements on specified quality characteristics of each item in a sample from a lot

[ISO 3534-2:2006, definition 4.2.11]

NOTE An acceptable process is a process that generates nonconforming items at a rate no worse than the AQL.

3.6
process average
rate at which nonconforming items are generated by a process

3.7
acceptance quality limit
AQL
worst tolerable product quality level

NOTE See Clause 5.

3.8
quality level
quality expressed as a rate of nonconforming units

3.9
limiting quality
LQ
quality level, when a lot is considered in isolation, which, for the purposes of acceptance sampling inspection, is limited to a low probability of acceptance (in this part of ISO 3951: 10 %)

NOTE See Clause 8.

3.10
nonconformity
non-fulfilment of a requirement

[ISO 9000:2005, definition 3.6.2]

NOTE 1 Nonconformity will generally be classified by its degree of seriousness, such as:

Class A. Nonconformity of a type considered to be of the highest concern for the product or service. Such types of nonconformity will typically be assigned very small AQL values.

Class B. Nonconformity of a type considered to have the next lower degree of concern; this is typically assigned a larger AQL value than that in class A and smaller than that in class C if a third class exists, and so on.

The number of classes and the assignment into a class should be appropriate to the quality requirements of the specific situation.

NOTE 2 The main text of this part of ISO 3951 deals with the univariate case, for which there will be either one or two classes of nonconformity.

3.11
nonconforming unit
unit with one or more nonconformities

[ISO 3534-2:2006, definition 1.2.15]

3.12
"s" **method acceptance sampling plan**
acceptance sampling plan by variables using the sample mean(s) and sample standard deviation(s)

NOTE See Clause 16.

3.13
"σ" **method acceptance sampling plan**
acceptance sampling plan by variables using the sample mean(s) and the presumed value(s) of the process standard deviation(s)

NOTE See Clause 17.

3.14
specification limit
limiting value stated for a characteristic

[ISO 3534-2:2006, definition 3.1.3]

3.15
lower specification limit
L
specification limit that defines the lower limiting value

[ISO 3534-2:2006, definition 3.1.5]

3.16
upper specification limit
U
specification limit that defines the upper limiting value

[ISO 3534-2:2006, definition 3.1.4]

3.17
combined control
requirement when nonconformity beyond both the upper and the lower specification limits of a quality characteristic belongs to the same class to which a single AQL is applied

NOTE 1 See 5.3, 16.4 and 17.4.

NOTE 2 The use of a combined AQL requirement implies that nonconformities beyond either specification limit are believed to be of equal, or at least roughly equal, importance to the lack of integrity of the product.

3.18
separate control
requirement when nonconformity beyond the upper and the lower specification limits of a quality characteristic belongs to different classes, to which separate AQLs are applied

NOTE See 5.3, 16.3 and 17.3.

3.19
complex control
requirement when nonconformity beyond both the upper and the lower specification limits of a quality characteristic belongs to one class and nonconformity beyond either the upper or the lower specification limit belongs to a different class, with separate AQLs being applied to the two classes

NOTE See 5.3, 16.5 and 17.5.

3.20
acceptability constants
k, p^*
constants depending on the specified value of the acceptance quality limit, sample size and inspection severity, used in the criteria for accepting the lot in an acceptance sampling plan by variables

NOTE 1 See Clauses 16 and 17.

NOTE 2 For double sampling, there will be three such pairs of acceptability constants, one for acceptance at the first sample, one for non-acceptance at the first sample and one for acceptance with the combined first and second samples.

3.21
quality statistic
Q
⟨acceptance sampling⟩ function of the specification limit, the sample mean, and the sample or process standard deviation, used in assessing the acceptability of a lot

[ISO 3534-2:2006, definition 4.4.9]

NOTE See also 3.22 and 3.23.

3.22
lower quality statistic
Q_L
function of the lower specification limit, the sample mean, and the sample or process standard deviation

NOTE See Clause 4 for further details.

3.23
upper quality statistic
Q_U
function of the upper specification limit, the sample mean, and the sample or process standard deviation

NOTE See Clause 4 for further details.

3.24
maximum sample standard deviation
MSSD
s_{max}
largest sample standard deviation for a given sample size code letter and acceptance quality limit for which it is possible to satisfy an acceptance criterion for double specification limits when the process variability is unknown

NOTE 1 The MSSD depends on whether the double specification limits are under combined, separate or complex control and on the inspection severity (i.e. normal, tightened or reduced).

NOTE 2 See 16.4.2 and Table 16, 17 or 18.

NOTE 3 For double sampling plans, there are two MSSDs under each combination of inspection severity and type of control, one for the first sample and one for the combined first and second samples.

3.25
maximum process standard deviation
MPSD
σ_{max}
largest process standard deviation for a given sample size code letter and acceptance quality limit for which it is possible to satisfy an acceptance criterion for double specification limits under all inspection severities (i.e. normal, tightened or reduced) when the process variability is known

NOTE 1 An MPSD depends on whether the double specification limits are under combined, separate or complex control, but does not depend on the inspection severity or on whether the sample is the first or second.

NOTE 2 See 17.3, 17.4 and 17.5 and Tables 19, 20 and 21.

3.26
switching rule
instruction within an acceptance sampling scheme for changing from one acceptance sampling plan to another of greater or lesser severity based on demonstrated quality history

NOTE 1 Normal, tightened or reduced inspection, or discontinuation of inspection, are examples of severity of sampling.

[ISO 3534-2:2006, definition 4.3.4]

NOTE 2 See Clause 21.

3.27
measurement
set of operations having the object of determining the value of a quantity

[ISO 3534-2:2006, definition 3.2.1]

3.28
average sample size
ASSI
average number of units in a sample inspected per lot in reaching decisions to accept or not to accept when using a given acceptance sampling scheme

NOTE ASSI is dependent on the actual quality level of the submitted lots.

[ISO 3534-2:2006, definition 4.7.3]

3.29
responsible authority
concept used to maintain the neutrality of this part of ISO 3951, irrespective of whether it is being invoked or applied by the first, second or third party

NOTE 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.

NOTE 2 The duties and functions of a responsible authority are outlined in this part of ISO 3951 (see 5.3, 6, 10, 11, 16.4.3.2.1, 17.1, 19.1, 20.2, 21.4, 23.1, 23.2 and 23.3).

4 Symbols and abbreviations

4.1 Symbols

For the purposes of this part of ISO 3951, the following symbols apply.

Ac	acceptance number
c_u	factor given in Table 29 for determining the upper control limit for sample standard deviations (see 23.2)
f_s	factor given in Tables 16, 17 and 18 for combined control of double specification limits, relating the maximum sample standard deviation (MSSD) to the difference between U and L, for normal, tightened and reduced inspection respectively (see 16.4.2 and 16.4.3.1) NOTE 1 $f_{s,1}$ and $f_{s,c}$ represent respectively the factors applicable to the standard deviation of the first sample and to the combined standard deviation of the first and second samples.
f_σ	factor given in Tables 19, 20 and 21 that relates the maximum process standard deviation (MPSD) to the difference between U and L, for combined, separate and complex control respectively (see 17.4 and 17.5)
k	Form k acceptability constant NOTE 2 k_a, k_r and k_c represent respectively the Form k acceptability and non-acceptability constants at the first sample and the acceptability constant for the combined first and second samples.
L	lower specification limit (as a suffix to a variable, denotes its value at L).
μ	process mean
N	lot size (number of items in a lot)
n	sample size (number of items in each sample)
p	process fraction nonconforming
$\hat{p}$	estimate of the process fraction nonconforming
$\hat{p}_L$	estimate of the process fraction nonconforming below the lower specification limit
$\hat{p}_U$	estimate of the process fraction nonconforming above the upper specification limit
p^*	Form p^* acceptability constant, the largest acceptable value of the estimate of the process fraction nonconforming NOTE 3 p_a^*, p_r^* and p_c^* represent respectively the Form p^* acceptability and non-acceptability constants at the first sample and the acceptability constant for the combined first and second samples.
P_a	probability of acceptance
Q	quality statistic
Q_L	lower quality statistic NOTE 4 Q_L is defined as $(\bar{x} - L)/s$ when the process standard deviation is unknown, and $(\bar{x} - L)/\sigma$ when it is presumed to be known. NOTE 5 $Q_{L,1}$ is defined as $(\bar{x}_1 - L)/s_1$ or $(\bar{x}_1 - L)/\sigma$; $Q_{L,c}$ is defined as $(\bar{x}_c - L)/s_c$ or $(\bar{x}_c - L)/\sigma$.
Q_U	upper quality statistic NOTE 6 Q_U is defined as $(U - \bar{x})/s$ when the process standard deviation is unknown, and $(U - \bar{x})/\sigma$ when it is presumed to be known. NOTE 7 $Q_{U,1}$ is defined as $(U - \bar{x}_1)/s_1$ or $(U - \bar{x}_1)/\sigma$; $Q_{U,c}$ is defined as $(U - \bar{x}_c)/s_c$ or $(U - \bar{x}_c)/\sigma$.

s sample standard deviation of the measured values of the quality characteristic, also an estimate of the process standard deviation, i.e.

$$s = \sqrt{\frac{\sum_{j=1}^{n}(x_j - \bar{x})^2}{n-1}} = \sqrt{\frac{n\sum_{j=1}^{n}x_j^2 - \left(\sum_{j=1}^{n}x_j\right)^2}{n(n-1)}}$$

s_{max} maximum allowable sample standard deviation (see 3.24)

NOTE 8 $s_{1,max}$ and $s_{c,max}$ represent, respectively, the maximum standard deviation for the first sample and the maximum standard deviation for the combined first and second samples (see also f_s).

σ standard deviation of a process whose inherent variability is under statistical control

NOTE 9 σ^2, the square of the standard deviation, is known as the process variance.

σ_{max} maximum allowable process standard deviation (see 3.25 and also f_σ)

U upper specification limit (as a suffix to a variable, denotes its value at U)

x_j measured value of the quality characteristic for the jth item of a sample

$\bar{x}$ arithmetic mean of the measured values of the quality characteristic in a sample, i.e.

$$\bar{x} = \frac{\sum_{j=1}^{n}x_j}{n}$$

NOTE 10 $\bar{x}_1$, $\bar{x}_2$ and $\bar{x}_c$ represent, respectively, the mean of the first sample, the mean of the second sample and the mean of the first and second samples combined. As the first and second sample sizes are equal, the combined sample mean takes the simple form $\bar{x}_c = (\bar{x}_1 + \bar{x}_2)/2$.

$\bar{x}_L$ lower acceptance value for $\bar{x}$

$\bar{x}_U$ upper acceptance value for $\bar{x}$

4.2 Abbreviations

AQL acceptance quality limit

ASSI average sample size

LQ limiting quality

MSSD maximum sample standard deviation

MPSD maximum process standard deviation

MVUE minimum variance unbiased estimator

OC operating characteristic

5 Acceptance quality limit (AQL)

5.1 Concept

The AQL is the quality level that is the worst tolerable process average when a continuing series of lots is submitted for acceptance sampling. Although individual lots with quality as bad as the acceptance quality limit might be accepted with fairly high probability, the designation of an acceptance quality limit does not suggest that this is a desirable quality level. The sampling schemes found in this part of ISO 3951, with their rules for switching and for discontinuation of sampling inspection, are designed to encourage suppliers to have process averages consistently better than the AQL, thereby protecting the consumer from the situation where the long run process average is worse than the AQL. Otherwise, there is a high risk that the inspection severity will be switched to tightened inspection, under which the criteria for lot acceptance become more demanding. Once on tightened inspection, unless action is taken to improve the process, it is very likely that the rule requiring discontinuation of sampling inspection will be invoked pending such improvement.

5.2 Use

The AQL, together with the sample size code letter, is used to index the sampling plans in this part of ISO 3951.

5.3 Specifying AQLs

The AQL to be used will be designated in the product specification, in the contract or by the responsible authority. In the case

a) where an upper specification limit for the quality characteristic is given, or

b) where a lower specification limit is given,

then a single AQL applies to the indicated limit.

Where both upper and lower specification limits are given for the quality characteristic, three further cases can be identified:

c) combined control of double specification limits, where a single AQL applies to the total percentage nonconforming beyond both limits;

d) separate control, where separate AQLs apply to the percent nonconforming beyond each limit;

e) complex control, where one AQL applies to the percent nonconforming beyond the limit that is of greater seriousness, while a larger AQL applies to the total percent nonconforming beyond both limits.

Acceptance tests shall be carried out according to the provisions of this part of ISO 3951 for each AQL. The lot shall only be accepted if the AQL requirement is satisfied in cases a), b) or c), or if both AQL requirements are satisfied in cases d) or e).

5.4 Preferred AQLs

The sixteen AQLs given in this part of ISO 3951, ranging in value from 0,01 % to 10 % nonconforming, are described as preferred AQLs. If, for any product or service, an AQL is designated other than a preferred AQL, then this part of ISO 3951 is not applicable. (See 14.2.)

5.5 Caution

From the above description of the AQL concept, it follows that the desired protection can only be assured when a continuing series of lots is provided for inspection.

5.6 Limitation

The designation of an AQL does not imply that the supplier has the right to knowingly supply any nonconforming items of product.

6 Switching rules for normal, tightened and reduced inspection

Switching rules discourage the producer from operating at a quality level that is worse than the AQL. This part of ISO 3951 prescribes a switch to tightened inspection when inspection results indicate that the process average is not satisfactory. It further prescribes a discontinuation of sampling inspection altogether if tightened inspection fails to stimulate the producer into rapidly improving his production process.

Tightened inspection and the discontinuation rule are integral, and therefore obligatory, procedures of this part of ISO 3951 if the protection implied by the AQL is to be maintained.

This part of ISO 3951 also provides the possibility of switching to reduced inspection when inspection results indicate that the quality level is stable and reliable at a level significantly better than the AQL. This practice is, however, optional (at the discretion of the responsible authority).

When there is sufficient evidence from the control charts (see 20.1) that the variability is in statistical control, consideration should be given to switching to the "σ" method. If this appears advantageous, the consistent value of s (the sample standard deviation) shall be taken as σ (see 23.1).

When it has been necessary to discontinue sampling inspection, inspection should not be resumed until action has been taken by the producer to improve the quality of the submitted product.

Details of the operation of the switching rules are given in Clauses 21, 22 and 23.

7 Relation to ISO 2859-1

7.1 Similarities to ISO 2859-1

a) The double sampling plans by variables in this part of ISO 3951 are complementary to the double sampling plans by attributes provided in ISO 2859-1; the two documents share a common philosophy and, as far as possible, their procedures and vocabulary are the same.

b) Both standards use the AQL to index the sampling plans and the preferred values used in this document are identical to those given for percent nonconforming in ISO 2859-1 (i.e. from 0,01 % to 10 %).

c) In this part of ISO 3951, lot size and inspection level (inspection level II in default of other instructions) determine a sample size code letter. Then, general tables give the sample sizes to be taken and the acceptability criteria, indexed by the sample size code letter and the AQL. Separate tables are given for the "s" and "σ" methods, and for normal, tightened and reduced inspection.

d) In this part of ISO 3951, the first and second sample sizes of the double sampling plans are the same.

e) The switching rules are essentially equivalent.

f) The operating characteristic (OC) curves of the variables plans in this part of ISO 3951 are closely matched to those of the corresponding single sampling attributes plans in ISO 2859-1 (see Annex M).

g) The classification of nonconformities by degree of seriousness into class A, class B, etc., remains unchanged.

7.2 Differences from ISO 2859-1

a) **Determination of acceptability**. Acceptability for an ISO 2859-1 attributes double sampling plan for percent nonconforming is determined by the numbers of nonconforming items found in the samples. Acceptability for a plan for inspection by variables is based on the distances of the estimated process means from the specification limit(s) in terms of the estimated or known process standard deviations or, by implication, the estimated process fractions nonconforming. In this part of ISO 3951, two methods are considered: the "s" method for use when the process standard deviation σ is unknown and the "σ" method for use when σ is presumed to be known. In the case of a single specification limit, or for separate control of double specification limits, acceptability is determined most easily by comparing quality statistics with "Form k" acceptability constants (see 16.2, 16.3, 17.2 and 17.3). For combined or complex control of double specification limits, acceptability is determined by comparing estimates of the process percent nonconforming for each class of nonconformity with "Form p^*" constants (see 16.4, 16.5, 17.4 and 17.5). (Annexes A, B and C provide procedures for two or more unrelated quality characteristics.)

b) **Normality**. In ISO 2859-1, there is no requirement relating to the distribution of the characteristics. However, in this part of ISO 3951, it is necessary for the efficient operation of the plans that the measurements should be distributed according to a normal distribution (or at least a close approximation to a normal distribution), either originally or after a known transformation.

c) **Sample sizes**. Unlike the sample sizes in ISO 2859-1, the sample sizes along rows of the master tables in this part of ISO 3951 are not constant. This was necessary to obtain closely matched OC curves [see 7.1 f)].

d) **Producer's risk**. For process quality precisely at the AQL, the producer's risk (see 8.3) that a lot will not be accepted is similar, but not identical, to the corresponding producer's risk in ISO 2859-1 (see Annex I).

e) **Average sample sizes (ASSIs).** The ASSIs of double sampling schemes by variables are generally much smaller than the ASSIs for corresponding schemes by attributes at any given process quality level (see Annex L).

f) **Multiple sampling plans**. No multiple sampling plans are given in this part of ISO 3951.

g) **Average outgoing quality limit (AOQL)**. The AOQL concept applies when 100 % inspection and rectification is feasible for non-accepted lots. It follows that the AOQL concept cannot be applied under destructive or expensive testing. As variables plans will generally be used under these circumstances, no tables of AOQL have been included in this part of ISO 3951.

8 Limiting quality protection

8.1 Use of individual plans

This part of ISO 3951 is intended to be used as a system employing tightened, normal and reduced inspection on a continuing series of lots to provide consumer protection while assuring the producer that acceptance will be very likely to occur if quality is better than the AQL.

Sometimes specific individual plans are selected from this part of ISO 3951 and used without the switching rules. For example, a purchaser might be using the plans for verification purposes only. This is not the intended application of the system given in this part of ISO 3951 and its use in this way should not be referred to as "inspection in compliance with ISO 3951-3". When used in such a way, ISO 3951-3 simply represents a collection of individual double sampling plans indexed by AQL. The operating characteristic curves and other measures of a plan so chosen should be assessed individually from the tables provided.

8.2 Consumer's risk quality tables

If the series of lots is not long enough to allow the switching rules to be applied, it might be desirable to limit the selection of sampling plans to those, associated with a designated AQL value, that give consumer's risk quality not more than the specified limiting quality protection. Sampling plans for this purpose may be selected by choosing a consumer's risk quality (CRQ) and a consumer's risk to be associated with it, and then referring to the tables on Charts C to R (see Figures 2 to 15).

8.3 Producer's risk tables

The producer's risk is the probability of non-acceptance under either the "s" or "σ" methods for lots produced when the process average equals the AQL. The producer's risks of the double sampling plans of this part of ISO 3951 are given for the "s" method in Annex I. The corresponding producer's risks for the "σ" method are broadly similar.

8.4 Operating characteristic curves

The tables for consumer's risk quality and producer's risk provide information about only two points on the OC curves. However, the degree of consumer protection provided by an individual sampling plan at any process quality may be judged from its OC curve. OC curves for the "s" method sampling plans of this part of ISO 3951 are given in Charts C to R, which should be consulted when choosing a sampling plan. Also given on these charts are respectively tables of process qualities at nine standard probabilities of acceptance for all the "s" method sampling plans in this part of ISO 3951.

Some of the OC curves in Charts C to R apply to tightened or reduced inspection as well as, or rather than, normal inspection. The numerical legend on the charts refers to normal inspection. To locate an OC curve for tightened or reduced inspection, examine the appropriate column of the corresponding table at the bottom of the page; if the relevant plan is not also used for normal inspection, it will be identified by the letter T (for tightened) or R (for reduced) followed by a number, e.g. R1, for cross-referencing to the corresponding OC curve.

EXAMPLE For tightened inspection with sample size code letter G, turn to Chart G. The OC curve for tightened inspection when the AQL is 2,5 % is the same as the one on the uppermost graph corresponding to an AQL of 1,5 % under normal inspection. For reduced inspection, it is necessary to turn back to the chart that is two pages earlier. For example, the OC curve for code letter G for an AQL of 0,65 % under reduced inspection is the one identified as R1 on the uppermost graph of Chart E.

These OC curves and tables apply to a single specification limit under the "s" method. Most of them also provide a good approximation to the "σ" method and to the cases of combined, separate or complex control of double specification limits, particularly for the larger sample sizes. If more accurate OC values are required for the "σ" method, refer to Annex J.

9 Planning

The choice of the most suitable variables plan, if one exists, requires experience, judgement and some knowledge both of statistics and the product to be inspected. Clauses 10 to 14 of this part of ISO 3951 are intended to help those responsible for specifying sampling plans in making this choice. They suggest the considerations that should be borne in mind when deciding whether a variables plan would be suitable, and the choices to be made when selecting an appropriate standard plan.

10 Choice between variables and attributes

The first question to consider is whether it is desirable to inspect by variables rather than by attributes. The following points should be taken into account.

a) In terms of economics, it is necessary to compare the total cost of the relatively simple inspection of a larger number of items by means of an attributes scheme with the generally more elaborate procedure required by a variables scheme, which is usually more time-consuming and costly per item.

b) In terms of the knowledge gained, the advantage lies with inspection by variables, as the information obtained indicates more precisely how good the product is. Earlier warning will therefore tend to be given if quality begins to deteriorate.

c) An attributes scheme can be more readily understood and accepted; for example, it might at first be difficult to accept that, when inspecting by variables, a lot can be rejected on measurements taken of a sample that does not contain any nonconforming items. (See Example 2 in 16.2.)

d) Enormous improvements in average sample size (ASSI) can be achieved by replacing double sampling schemes by attributes by double sampling schemes by variables. Annex L illustrates this for normal, tightened and reduced inspection, showing the maximum and minimum values of the quotients of the ASSI for double sampling by variables and the ASSI for the corresponding schemes by attributes. The tables in Annex L show that the advantage of using "s" method double sampling plans tends to become more marked with increases in lot size and decreased in the AQL.

NOTE 1 For normal and tightened inspection, the corresponding schemes by attributes on and below the fourth diagonal of the master tables are double sampling schemes. For reduced inspection, the corresponding schemes by attributes on and below the fifth diagonal of the master tables are double sampling schemes. For normal, tightened and reduced inspection, the attributes schemes corresponding to the first diagonal are single sampling schemes with accept number zero. For all other diagonals on the master tables, the corresponding attributes scheme is a single sampling plan with a fractional accept number.

e) Inspection by variables is particularly appropriate in conjunction with the use of control charts for variables.

f) Variables sampling has a substantial advantage when the inspection process is expensive, for example in the case of destructive testing.

g) The use of this part of ISO 3951 is only applicable when there is reason to believe that the distribution of measurements of each quality characteristic is normal, or normal after a known transformation, and that the quality characteristics are independent. In the case of doubt, the responsible authority should be consulted.

NOTE 2 ISO 5479 gives detailed procedures for tests for departure from normality.

NOTE 3 Departure from normality is also dealt with in ISO 2854, which provides examples of graphical methods which can be used to verify that the distribution of the data is sufficiently normal to justify the use of sampling by variables.

11 Choice of method

If it is desired to apply inspection by variables, the next question is whether to use the "s" method or the "σ" method. As already indicated in 10 d) above, the "σ" method is the most economical in terms of sample size but, before this method may be employed, the value of σ has to be established.

Initially, it will be necessary to begin with the "s" method but, subject to the agreement of the responsible authority and provided the quality remains satisfactory, the standard switching rules will permit a switch to reduced inspection and the use of a smaller sample size.

The question then is, if the variability is under control and lots continue to be accepted, will it be economical to change to the "σ" method? The sample sizes will generally be smaller and the acceptability criteria simpler to implement under the "σ" method. On the other hand, it will still be necessary to calculate the sample standard deviations s for record purposes and to keep the control charts up to date. (See Clause 20.)

12 Choice between single and double sampling plans

Another question to consider is whether it is preferable to use single sampling or double sampling plans.

The advantage of using double sampling plans is that the average amount of sampling is reduced, the reduction depending on the process quality level. The maximum and minimum percentage reductions in the average sample sizes (ASSIs) for double sampling schemes in comparison with the sample size for the corresponding single sampling plans by variables are shown for normal inspection in Annex K. Table K.1 shows the reductions for the "s" method (used when the process standard deviation is unknown) and Table K.2 for the "σ" method (used when the process standard deviation is presumed to be known).

NOTE Annexes F and G provide the corresponding "s" method and "σ" method single sampling plans by variables used in these comparisons.

However, double sampling plans can also have a number of disadvantages. When items take a long time to test, but can be inspected or tested simultaneously, replacing a single sampling plan by a double sampling plan can double the time needed to produce an accept or non-accept decision. This problem is exacerbated if time has to be booked in advance at the inspection facility.

Even worse is the case where items need to be transported a considerable distance to be tested. This raises a number of questions. Should both samples be transported to the inspection facility at the same time? Should time for one or for both samples to be inspected be booked in advance, i.e. what are the costs of booking time that is subsequently not used? If the second sample is transported but not required, can it be transported back again and returned to the lot from which it was drawn, i.e. can it be assumed to be not adversely affected by its long journey? Will any delay caused by the use of double sampling cause a storage problem for the lots that are awaiting a disposition decision? Are the savings from the use of double sampling more than cancelled out by extra administrative and logistical costs?

The decision whether or not to replace single sampling plans by double sampling plans therefore depends on whether the potential savings from the reduction in the average amount of sampling and inspection outweighs the negative aspects of double sampling.

13 Choice of inspection level and AQL

For a standard sampling plan, the inspection level, in conjunction with the size of the lots and the AQL, determines the size of the sample to be taken and governs the severity of the inspection. The appropriate OC curve or table from Charts C to R shows the extent of the risk that is involved in such a plan.

The choice of inspection level and AQL is governed by a number of factors, but is mainly a balance between the total cost of inspection and the consequences of nonconforming items passing into service.

The normal practice is to use inspection level II, unless special circumstances indicate that another level is more appropriate.

14 Choice of sampling scheme

14.1 Standard schemes

The standard procedure may be used only when the production of lots is continuing.

This standard procedure, with its semi-automatic steps from lot size to sample size, using inspection level II and beginning with the "s" method, has been found in practice to produce workable sampling plans, but it rests on the assumption that the order of priority is first the AQL, second the sample size and last, probabilities of acceptance at poorer quality levels such as the indifference and limiting qualities.

NOTE The indifference and limiting qualities are the quality levels which, if offered for inspection, would have a 50 % or 10 % probability of acceptance, respectively. However, the actual risk taken by the consumer varies according to the probability that goods at such low quality levels are offered for inspection.

The acceptability of this system is due to the fact that the consumer is protected by the switching rules (see Clauses 21, 22 and 23), which quickly increase the severity of inspection and finally terminate inspection altogether if the quality of the process remains worse than the AQL.

However, if, in certain circumstances, these lower quality levels have a higher priority than the sample size (for example, when only a limited number of lots are being produced), a suitable scheme from this part of ISO 3951 may be selected by using Chart A (see Figure 1). Construct a vertical line through the acceptable value for the indifference quality and a horizontal line through the desired quality with a 95 % probability of acceptance (i.e. approximately equal to the AQL). The point of intersection of these two lines will lie on, or under, a curve indexed by the sample size code letter of a standard normal inspection double sampling scheme, which meets the specified requirements. This should be verified by inspecting the OC curve from among Charts C to R relating to this code letter and AQL.

EXAMPLE

Suppose that an acceptable value for the indifference quality is 3,0 % nonconforming and that the desired quality with a 95 % probability of acceptance is 1,0 % nonconforming. A vertical line on Chart A (see Figure 1) at 3,0 % nonconforming and a horizontal line at 1,0 % nonconforming intersect just below the sloping line indexed by the letter K. Examining Chart K, it is seen that a plan with sample size code letter K and AQL 1,0 % meets the requirements.

If the lines intersect at a point above the line marked R in Chart A, this indicates that the specification cannot be met by any of the plans in this part of ISO 3951.

14.2 Special schemes

If none of the standard schemes are acceptable, it will be necessary to devise a special scheme. It then has to be decided which combination of AQL, limiting quality, and sample sizes is most suitable, remembering that these are not independent for, when any two have been chosen, the third follows.

NOTE This choice is not completely unfettered; the fact that the sizes of the samples are necessarily whole numbers, and that for pragmatic reasons they are constrained to be equal, imposes some limitations. If a special scheme is necessary, it should be devised only with the assistance of a statistician experienced in quality control.

15 Preliminary operations

Before starting inspection by variables,

a) check that production is considered to be continuing and that the distribution of the quality characteristic can be considered to be normal or may be transformed to a normal distribution;

NOTE If lots have been screened for nonconforming items prior to acceptance sampling, then the distribution will have been truncated and this part of ISO 3951 will not be applicable.

b) check whether the "s" method is to be used initially or whether the process standard deviation is stable and known, in which case, the "σ" method should be used;

c) check that the inspection level to be used has been designated. If none has been given, use inspection level II;

d) check, when the quality characteristic has double specification limits, whether the limits are under combined, separate or complex control. For combined control, check that nonconformity beyond each limit is of equal importance; for separate or complex control, check to which class of nonconformity each limit has been assigned;

e) check that an AQL has been designated for each class of nonconformity, and that it is one of the preferred AQLs used in this part of ISO 3951. If it is not, then the tables are not applicable.

16 Standard univariate "s" method procedures

16.1 Obtaining a plan, sampling and preliminary calculations

The procedure for obtaining and implementing a plan is as follows.

a) With the inspection level given (normally this will be II) and with the lot size, obtain the sample size code letter from Table 9.

b) For a single specification limit, enter Table 10, 11 or 12 (for normal, tightened or reduced inspection, respectively) with this code letter and the AQL, and obtain the sample sizes n and the Form k acceptability constants k_a, k_r and k_c. For separate control of double specification limits, do this for both limits. For combined control of double specification limits, enter Table 23, 24 or 25, as appropriate, and obtain the sample sizes n and the Form p^* acceptability constants p_a^*, p_r^* and p_c^*. For complex control of double specification limits, enter Table 23, 24 or 25, as appropriate, twice, once with the AQL applying to the combined control part of the specification and once with the smaller AQL that applies to the more serious specification limit.

c) Take an initial random sample of size n, measure the characteristic x in each item and then calculate the sample mean $\bar{x}_1$ and the estimate s_1 of the process standard deviation.

16.2 Form k acceptance procedure for the "s" method — Single specification limit

For a single specification limit, the simplest procedure is as follows.

Calculate the quality statistic

$$Q_{U,1} = \frac{U - \bar{x}_1}{s_1} \text{ or } Q_{L,1} = \frac{\bar{x}_1 - L}{s_1}$$

as appropriate.

a) If the quality statistic ($Q_{U,1}$ or $Q_{L,1}$) is greater than or equal to k_a, then, without a second random sample being required, the lot is acceptable.

b) If the quality statistic is less than or equal to k_r, then, again without a second random sample being required, the lot is non-acceptable.

c) If the quality statistic lies between k_r and k_a, then draw a second random sample of the same size from the lot, and calculate its mean $\bar{x}_2$ and standard deviation s_2.

Next, calculate the combined sample mean,

$$\bar{x}_c = (\bar{x}_1 + \bar{x}_2)/2$$

the combined standard deviation,

$$s_c = \sqrt{(s_1^2 + s_2^2)/2}$$

and the combined quality statistic

$$Q_{U,c} = \frac{U - \bar{x}_c}{s_c} \text{ or } Q_{L,c} = \frac{\bar{x}_c - L}{s_c}$$

as appropriate. If the combined quality statistic is greater than or equal to k_c, then the lot shall be accepted; otherwise, it shall be non-accepted.

In summary, if only the upper specification limit U is given, the lot is

— acceptable if $Q_{U,1} \geqslant k_a$, or if $k_r < Q_{U,1} < k_a$ and $Q_{U,c} \geqslant k_c$; or

— non-acceptable if $Q_{U,1} \leqslant k_r$, or if $k_r < Q_{U,1} < k_a$ and $Q_{U,c} < k_c$;

or, if only the lower specification limit L is given, the lot is:

— acceptable if $Q_{L,1} \geqslant k_a$, or if $k_r < Q_{L,1} < k_a$ and $Q_{L,c} \geqslant k_c$; or

— non-acceptable if $Q_{L,1} \leqslant k_r$, or if $k_r < Q_{L,1} < k_a$ and $Q_{L,c} < k_c$.

EXAMPLE 1

"s" method, upper specification limit

The maximum temperature of operation for a certain device is specified as 60 °C. Production is inspected in lots of 100 items. The process standard deviation is unknown. Inspection level II and normal inspection with AQL = 2,5 % are to be used.

From Table 9, it is found that the sample size code letter is F. From Table 10, it is seen that samples of size 8 are required under normal inspection, and that the acceptability constants k_a, k_r and k_c are 1,677, 1,160 and 1,476 respectively. Suppose that the temperature measurements of the eight devices in the first sample are as follows: 58 °C; 59 °C, 54 °C; 58 °C; 50 °C; 50 °C; 55 °C; 54 °C. Conformance to the acceptability criteria is to be determined. The analysis is shown in Table 1.

Table 1 — Example of "s" method analysis for an upper specification limit

Information needed	Values obtained
Size of first sample: n	8
Upper specification limit: U	60 °C
Form k acceptability constant at the first sample: k_a	1,677
Form k non-acceptability constant at the first sample: k_r	1,160
Mean of first sample: $\bar{x}_1$	54,75 °C
Standard deviation of first sample: s_1	3,495 °C
Quality statistic at the upper specification limit for the first sample: $Q_{U,1} = (U - \bar{x}_1)/s_1$	1,502
As $k_r < Q_{U,1} < k_a$, a second sample of 8 devices is required in order to determine lot acceptability. Suppose that the measurements for the second sample are 56 °C; 58 °C, 55 °C; 55 °C; 56 °C; 52 °C; 51 °C; 59 °C.	
Form k acceptability constant for the combined first and second samples: k_c	1,476
Mean of second sample: $\bar{x}_2$	55,25 °C
Standard deviation of second sample: s_2	2,712 °C
Combined sample mean: $\bar{x}_c = (\bar{x}_1 + \bar{x}_2)/2$	55,00 °C
Combined sample standard deviation: $s_c = \sqrt{(s_1^2 + s_2^2)/2}$	3,128 °C
Quality statistic at the upper specification limit for the combined sample: $Q_{U,c} = (U - \bar{x}_c)/s_c$	1,598
As $Q_{U,c} > k_c$, the lot meets the acceptability criteria and is therefore acceptable.	

EXAMPLE 2

"s" method, lower specification limit, requiring the following of an arrow in the master table

A certain pyrotechnic delay mechanism has a specified minimum delay time of four seconds. Production is inspected in lots of 1 000 items and inspection level II, normal inspection, is to be used with an AQL of 0,1 % applied to the lower limit. The process standard deviation is unknown.

From Table 9, it is seen that the sample size code letter is J. However, on entering Table 10 with sample size code letter J and AQL 0,1 %, it is found that there is an arrow pointing to the cell below. This means that an entirely suitable plan is unavailable, and the next best plan is given by sample size code letter K, i.e. sample sizes 18 and acceptability constants $k_{\text{a}} = 2{,}923$, $k_{\text{r}} = 2{,}389$ and $k_{\text{c}} = 2{,}562$. A random sample of size 18 is drawn. Suppose that the sample delay times, in seconds, are as follows: 5,05, 4,14, 4,78, 4,73, 4,75, 4,62, 4,69, 4,96, 4,67, 5,01, 4,50, 4,54, 4,44, 4,24, 4,25, 4,39, 4,73, 4,80.

Conformance to the acceptability criterion is to be determined. Details of the analysis are given in Table 2.

Table 2 — Example of "s" method analysis for a lower specification limit

Information needed	Values obtained
Size of first sample: n	18
Lower specification limit: L	4,0 s
Form k acceptability constant at the first sample: k_{a}	2,923
Form k non-acceptability constant at the first sample: k_{r}	2,389
Mean of first sample: $\bar{x}_1 = \sum x/n$	4,627 2 s
Standard deviation of first sample: $s_1 = \sqrt{\sum_j (x_j - \bar{x})^2/(n-1)}$	0,263 0 s
Quality statistic at the lower specification limit for the first sample: $Q_{L,1} = (\bar{x}_1 - L)/s_1$	2,385
Initial acceptability criterion: Is $Q_{L,1} \geqslant k_{\text{a}}$?	No
Initial non-acceptability criterion: Is $Q_{L,1} \leqslant k_{\text{r}}$?	Yes
As the quality statistic is less than k_{r}, the lot is deemed to be non-acceptable without the need to select a second random sample.	

NOTE The lot is non-acceptable even though all the sampled delay times are within specification.

16.3 Form k acceptance procedure for the "s" method — Separate control of double specification limits

Under separate control of double specification limits, the Form k acceptability constants at L and U will generally be different. Denote them by $k_{L,\text{a}}$, $k_{L,\text{r}}$ and $k_{L,\text{c}}$, and by $k_{U,\text{a}}$, $k_{U,\text{r}}$ and $k_{U,\text{c}}$ respectively. In this case, the lot is acceptable if

$Q_{U,1} \geqslant k_{U,\text{a}}$, or $k_{U,\text{r}} < Q_{U,1} < k_{U,\text{a}}$ and $Q_{U,\text{c}} \geqslant k_{U,\text{c}}$; and

$Q_{L,1} \geqslant k_{L,\text{a}}$, or $k_{L,\text{r}} < Q_{L,1} < k_{L,\text{a}}$ and $Q_{L,\text{c}} \geqslant k_{L,\text{c}}$.

Otherwise, the lot is non-acceptable, i.e. if

$Q_{U,1} \leqslant k_{U,\text{r}}$; or

$Q_{L,1} \leqslant k_{\text{L,r}}$; or

$k_{U,\text{r}} < Q_{U,1} < k_{U,\text{a}}$ and $Q_{U,\text{c}} < k_{U,\text{c}}$; or

$k_{L,\text{r}} < Q_{L,1} < k_{L,\text{a}}$ and $Q_{L,\text{c}} < k_{L,\text{c}}$.

The required sample sizes at the two limits might well be unequal. In such cases, either draw separate samples or use the larger sample size and identify the sample items as to their order of selection so that the mean and standard deviation of the smaller sample can also be determined.

EXAMPLE 3

"s" *method, separate control of double specification limits, unequal sample sizes at the limits*

Car battery acid is supplied separately from the dry batteries in plastic cartons with nominal contents of 500 cl. If there is insufficient acid, the battery electrodes will be insufficiently covered, whereas, if there is too much, the consumer will have a problem of disposing of the surplus acid. Past evidence supports the view that the machine used to fill the cartons supplies a quantity of acid that is normally distributed from carton to carton within each lot. A lower specification limit of 495 cl has been set with an AQL of 0,40 %, and an upper specification limit of 505 cl with an AQL of 1,5 %. The limits are to be controlled separately, and the process standard deviation is unknown. Lots of 250 cartons are to be inspected at inspection level II.

From Table 9, it is found that the sample size code letter is G. Details of the determination of the acceptability of the first lot are given in Table 3.

Table 3 — Example of "s" method analysis for separate control of double specification limits

Information needed	Value obtained
Lower specification limit: L	495 cl
Sample size code letter (from Table 9)	G
AQL for lower specification limit	0,40 %
Required initial sample size (from Table 10): n_L	10
Acceptability constant at lower limit for first sample: $k_{L,\mathrm{a}}$	2,463
Non-acceptability constant at lower limit for first sample: $k_{L,\mathrm{r}}$	1,863
Upper specification limit: U	505 cl
AQL for upper specification limit	1,5 %
Required initial sample size: n_U	12
Acceptability constant at upper limit for first sample: $k_{U,\mathrm{a}}$	1,907
Non-acceptability constant at upper limit for first sample: $k_{U,\mathrm{r}}$	1,439
A sample of 12 cartons is selected at random from the first lot. In order of selection, the sampled cartons were found to contain 497,2 cl, 504,0 cl, 503,7 cl, 499,5 cl, 498,2 cl, 501,3 cl, 501,8 cl, 500,1 cl, 502,4 cl, 499,9 cl, 496,4 cl and 498,7 cl.	
Mean of initial sample for lower specification limit: $\bar{x}_{L,1}$	500,79 cl
Standard deviation of initial sample for lower specification limit: $s_{L,1}$	2,266 9 cl
Quality statistic at lower specification limit: $Q_{L,1} = (\bar{x}_{L,1} - L)/s_{L,1}$	2,554 1
Is $Q_{L,1} \geqslant k_{L,\mathrm{a}}$?	Yes
The lot is acceptable as far as the lower specification limit is concerned. Now consider the upper specification limit.	
Mean of initial sample for upper specification limit: $\bar{x}_{U,1}$	500,25 cl
Standard deviation of initial sample for upper specification limit: $s_{U,1}$	2,456 7 cl
Quality statistic at upper specification limit: $Q_{U,1} = (U - \bar{x}_{U,1})/s_{U,1}$	1,933 5
Is $Q_{U,1} \geqslant k_{U,\mathrm{a}}$?	Yes
The acceptability criteria at both limits are satisfied at the first sample, so the lot is acceptable.	

If $Q_{U,1}$ had turned out to be 1,8, say, then it would have been found that $Q_{U,1}$ lay between $k_{U,\mathrm{r}}$ and $k_{U,\mathrm{a}}$. In such a case, the acceptability of the lot with regard to the upper specification limit would have been unresolved at the first sample, and a second sample of size 12 would have been necessary. As acceptability of the lot with regard to the lower specification limit has already been established, this second sample would only be used for the purposes of resolving the acceptability at the upper limit.

16.4 Form p^* acceptance procedure for the "s" method — Combined control of double specification limits

16.4.1 Introduction

This part of ISO 3951 provides both Form k and Form p^* methods for determining lot acceptability. Form k applies only to a single quality characteristic with either a single specification limit or with double specification limits that are to be controlled separately. Form p^* may be applied much more generally to single or multiple quality characteristics with any combination of single or double specification limits and with combined, separate or complex control.

16.4.2 Maximum sample standard deviation (MSSD)

If combined or complex control of both the upper and lower specification limits is required, there will be an overall AQL for the total percentage of the process outside the two specification limits, so the first step is to check that the standard deviation s_1 of the initial sample is not so large that lot acceptability is impossible. If the value of s_1 exceeds the value of the maximum sample standard deviation (MSSD) determined as $s_{1,\max} = (U - L) f_{s,1}$ with the aid of Table 16, 17 or 18, no further calculation is necessary, for the lot shall be immediately judged non-acceptable.

16.4.3 Further procedures for combined control

16.4.3.1 Exact procedures

If the value of s_1 does not exceed $s_{1,\max}$, calculate the estimate $\hat{p}_1$ of the process fraction nonconforming from the initial sample as described in **E.3.1**, **E.4.1**, **E.5**, **E.6** or **E.7** of Annex E, and compare it with the appropriate Form p^* acceptability constants p_a^* and p_r^* provided in Table 23, 24 or 25. The lot is:

acceptable if $\hat{p}_1 \leqslant p_\mathrm{a}^*$;

non-acceptable if $\hat{p}_1 \geqslant p_\mathrm{r}^*$.

If $p_\mathrm{a}^* < \hat{p}_1 < p_\mathrm{r}^*$, select a second random sample of the same size and calculate the statistics $\bar{x}_\mathrm{c}$ and s_c (see **16.2**). Find the appropriate value of $f_{s,\mathrm{c}}$ from Table 16, 17 or 18. If the value of s_c exceeds the value of the MSSD determined as $s_{\mathrm{c},\max} = (U - L) f_{s,\mathrm{c}}$, no further calculation is necessary and the lot is non-acceptable.

If the value of s_c does not exceed the value of the MSSD, calculate the estimate $\hat{p}_\mathrm{c}$ of the process fraction nonconforming from the combined sample as described in Annex E, and compare it with p_c^*. The lot is:

acceptable if $\hat{p}_\mathrm{c} \leqslant p_\mathrm{c}^*$;

non-acceptable if $\hat{p}_\mathrm{c} > p_\mathrm{c}^*$.

16.4.3.2 Simplified exact formulae for $\hat{p}$ for sample sizes 3 and 4

Clauses **E.6** and **E.7** of Annex E provide simplified exact formulae for the estimate of the process fraction nonconforming for samples of size 3 and 4 respectively.

16.4.3.2.1 Tabular method for evaluating $\hat{p}$ when the sample size is 3

Tables 10, 11 and 12 contain combinations of sample size code letter and AQL for which the required sample size is 3. For these cases, the estimate from the first sample of the process fractions nonconforming beyond the upper and lower specification limits may be found by entering Table 22 with $\sqrt{3}Q_{U,1}/2$ and $\sqrt{3}Q_{L,1}/2$ to find $\hat{p}_{U,1}$ and $\hat{p}_{L,1}$ respectively.

NOTE Negative values of Q correspond to estimates of the process percent nonconforming in excess of 50 % at that specification limit and will consequently always, except for small lots under reduced inspection with an AQL of 10 %, result in lot non-acceptance under the provisions of this part of ISO 3951. However, for the purposes of record-keeping under these circumstances, the estimate of the process fraction nonconforming may be obtained by entering Table 22 with the absolute value of $\sqrt{3}Q/2$ and subtracting the result from 1,0. For example: if $Q_{U,1} = -0{,}156$ then $\sqrt{3}Q_{U,1}/2 = -0{,}135$; entering Table 22 with 0,135 gives an estimate of 0,456 9; subtracting this from 1,0 gives $\hat{p}_{U,1} = 0{,}543\ 1$.

EXAMPLE

"s" method, combined control, n = 3, simplified exact formula used on results of first sample, second sample required, normal approximation used on results of combined sample

Projectiles supplied in batches of 100 are to be inspected for accuracy in the horizontal plane. Positive or negative angular errors are equally non-acceptable, so a combined AQL requirement for double specification limits is appropriate. The process standard deviation is unknown. The specification limits are set at 10 m on either side of the point of aim at a distance of one kilometre from the firing point, with an AQL of 10 %. Because testing is destructive and very costly, it has been agreed between the producer and the responsible authority that special inspection level S-3 is to be used.

From Table 9, the sample size code letter is found to be C. From Table 10, it is seen that samples of size 3 are required under normal inspection. Three projectiles are tested, yielding deviations from the point of aim of –5,0 m, 6,7 m and 8,8 m. Conformance to the acceptability criterion under normal inspection is to be determined.

Details of the acceptance sampling procedure are provided in Table 4.

Table 4 — Example of "s" method analysis for combined control of double specification limits (n = 3)

Information needed	Value obtained
Size of initial sample: n	3
Mean of initial sample: $\bar{x}_1$	3,5 m
Standard deviation of initial sample: s_1	7,435 7 m
Value of $f_{s,1}$ for MSSD (Table 16)	0,712 4
Lower specification limit: L	–10 m
Upper specification limit: U	10 m
MSSD = $s_{1,\max} = (U - L) f_{s,1}$ = 0,7124 × [10 – (–10)]	14,248 m
As s_1= 7,435 7 < $s_{1,\max}$ = 14,248, the lot might be acceptable, so continue with the calculations.	
$Q_{U,1} = (U - \bar{x}_1)/s_1$ = (10 – 3,5) / 7,435 7	0,874 16
$Q_{L,1} = (\bar{x}_1 - L)/s_1$ = (3,5 + 10) / 7,435 7	1,815 57
$\sqrt{3}Q_{U,1}/2$	0,757 04
$\sqrt{3}Q_{L,1}/2$	1,572 32
$\hat{p}_{U,1}$ (from Table 22)	0,226 6
$\hat{p}_{L,1}$ (from Table 22)	0,000 0
$\hat{p}_1 = \hat{p}_{U,1} + \hat{p}_{L,1}$	0,226 6
p_a^* (from Table 23, as it is normal inspection)	0,202 9
p_r^* (from Table 23, as it is normal inspection)	0,430 8

Table 4 *(continued)*

Information needed	Value obtained
As $p_a^* < \hat{p}_1 < p_r^*$, a second sample is required in order to determine lot acceptability.	
Size of second sample: n	3
Suppose that the second sample consists of deviations –3,1 m, 2,8 m and –6,6 m.	
Mean of second sample: $\bar{x}_2$	–2,3 m
Combined sample mean: $\bar{x}_c = (\bar{x}_1 + \bar{x}_2)/2$	0,6 m
Standard deviation of second sample: s_2	4,750 79 m
Combined standard deviation: $s_c = \sqrt{(s_1^2 + s_2^2)/2}$	6,239 39 m
Value of $f_{s,c}$ for MSSD (Table 16)	0,472 1
MSSD = $s_{c,max} = (U - L) f_{s,c}$	9,442 m
As s_c = 6,239 < $s_{c,max}$ = 9,442, the lot might be acceptable, so continue with the calculations.	
$Q_{U,c} = (U - \bar{x}_c)/s_c = (10 - 0{,}6)/6{,}23939$	1,506 56
$Q_{L,c} = (\bar{x}_c - L)/s_c = [0{,}6 - (-10)]/6{,}23939$	1,698 88
The example is continued using the procedure given in E.5.	
Combined sample size: $N = 2n$	6
Step b of E.5 for upper limit: $v_{U,c} = \frac{1}{2}\left(1 - Q_{U,c}\sqrt{N/\{(N-1)(N-2)\}}\right)$	0,087 41
Step b of E.5 for lower limit: $v_{L,c} = \frac{1}{2}\left(1 - Q_{L,c}\sqrt{N/\{(N-1)(N-2)\}}\right)$	0,034 74
Constant from Table E.1: a_n	0,731 350
Step c of E.5 for upper limit: $y_{U,c} = a_n \ln\{v_{U,c}/(1 - v_{U,c})\}$	–1,715 49
Step c of E.5 for lower limit: $y_{L,c} = a_n \ln\{v_{L,c}/(1 - v_{L,c})\}$	–2,431 34
Step d of E.5 for upper limit: $w_{U,c} = y_{U,c}^2 - 3$	–0,057 1
Step d of E.5 for lower limit: $w_{L,c} = y_{L,c}^2 - 3$	2,911 4
Step e of E.5 for upper limit: $m = N - 2$	4
Step f of E.5 for upper limit: $w_{U,c} < 0$, so $t_{U,c} = 12(m-1)y_{U,c}/[12(m-1) + w_{U,c}]$	–1,718 2
Step f of E.5 for lower limit: $w_{L,c} > 0$, so $t_{L,c} = 12 m y_{L,c}/[12m + w_{L,c}]$	–2,292 3
Step g of E.5 for upper limit (from tables of the normal distribution function): $\hat{p}_{U,c} = \Phi(t_{U,c})$	0,042 88
Step g of E.5 for lower limit (from tables of the normal distribution function): $\hat{p}_{L,c} = \Phi(t_{L,c})$	0,010 94
Estimate of the total fraction nonconforming: $\hat{p}_c = \hat{p}_{U,c} + \hat{p}_{L,c} =$ 0,042 88 + 0,010 94	0,053 82
p_c^* (from Table 23, as it is normal inspection)	0,305 2
As $\hat{p}_c < p_c^*$, the lot is acceptable.	

16.4.3.2.2 Tabular method for evaluating $\hat{p}$ when the sample size is 4

Tables 10, 11 and 12 contain combinations of sample size code letter and AQL for which the required sample size is 4. For these cases, the estimate from the first sample of the process fractions nonconforming beyond the upper and lower specification limits may be found as $\hat{p}_{U,1} = \max\left\{0, \min\left(1, \frac{1}{2} - \frac{1}{3}Q_{U,1}\right)\right\}$ and $\hat{p}_{L,1} = \max\left\{0, \min\left(1, \frac{1}{2} - \frac{1}{3}Q_{L,1}\right)\right\}$, where max($x$,$y$), min($x$,$y$) are respectively the maximum and minimum of the two arguments x and y.

EXAMPLE

"s" *method, combined control,* $n = 4$

Items are being manufactured in lots of size 50. The lower and upper specification limits on their diameters are 82 mm and 84 mm. The process standard deviation is unknown. Items with diameters that are too large are equally unsatisfactory as those with diameters that are too small, and it has been decided to control the total fraction nonconforming beyond either limit using an AQL of 6,5 % at inspection level II. Normal inspection is to be instituted at the beginning of inspection operations.

From Table 9, the sample size code letter is found to be D. From Table 10, it is seen that samples of size 4 are required under normal inspection. The diameters of an initial sample of four items from the first lot are measured, yielding diameters 82,4 mm, 82,2 mm, 83,1 mm and 82,3 mm. Conformance to the acceptability criterion under normal inspection is to be determined.

Details of the analysis are given in Table 5.

Table 5 — Example of "s" method analysis for combined control of double specification limits ($n = 4$)

Information needed	Value obtained
Size of initial sample: n	4
Upper specification limit: U	84,0 mm
Lower specification limit: L	82,0 mm
Mean of first sample: $\bar{x}_1$	82,50 mm
Standard deviation of first sample: s_1	0,408 2 mm
Factor for maximum of first sample standard deviation (from Table 16): $f_{s,1}$	0,478 5
Maximum of first sample standard deviation: $s_{1,\max} = (U-L)f_{s,1} = 0{,}4785 \times (84{,}0 - 82{,}0)$	0,957 0 mm
As $s_1 = 0{,}4082 < s_{1,\max} = 0{,}9570$, the lot *might* be acceptable, so continue with the calculations.	
Quality statistic for upper limit: $Q_{U,1} = (U - \bar{x}_1)/s_1 = (84{,}0 - 82{,}5) / 0{,}4082$	3,675
Quality statistic for lower limit: $Q_{L,1} = (\bar{x}_1 - L)/s_1 = (82{,}5 - 82{,}0) / 0{,}4082$	1,225
Estimate from first sample of fraction nonconforming above U (from E.7, and as $Q_{U,1} > 3/2$): $\hat{p}_{U,1}$	0,000 0
Estimate from first sample of fraction nonconforming below L (from E.7, as $\frac{1}{2} - \frac{1}{3}Q_{L,1}$): $\hat{p}_{L,1}$	0,091 7
Estimate from first sample of total fraction nonconforming: $\hat{p}_1 = \hat{p}_{U,1} + \hat{p}_{L,1}$	0,091 7
Form p^* acceptability constant for first sample (from Table 23): p_a^*	0,100 3
As $\hat{p}_1 < p_a^*$, the lot is acceptable.	

16.4.3.3 Approximative formulae for $\hat{p}$ for a sample of size 5 or more

When the sample is of size 5 or more, accurate normal approximations to the exact estimates of the fraction nonconforming may be obtained using the procedure given in **E.5**.

EXAMPLE
"s" method, combined control, $n \geqslant 5$, approximative method used to evaluate $\hat{p}$.

The minimum temperature of operation for a certain device is specified as 60 ºC and the maximum temperature as 70 °C. Production is in inspection lots of 96 items. The process standard deviation is unknown. Inspection level II, normal inspection, with AQL = 1,5 %, is to be used.

From Table 9, it is found that the sample size code letter is F. From Table 23, it is found that samples of size 11 are required under normal inspection, and that the Form p^* acceptance constants are $p_a^* = 0{,}017\ 50$, $p_r^* = 0{,}069\ 94$ and $p_c^* = 0{,}038\ 08$. From Table 16, it is found that the value of $f_{s,1}$ for the MSSD of the initial sample under normal inspection is 0,293 4, and that $f_{s,c}$ for the combined sample is 0,251 3. The measurements obtained for the initial sample are as follows: 63,5 °C; 62,0 °C; 65,2 °C; 61,7 °C; 69,0 °C; 67,1 °C; 60,0 °C; 66,4 °C; 62,8 °C; 68,0 °C; 63,4 °C. Conformance to the acceptability criterion is to be determined.

Details of the analysis are given in Table 6.

Table 6 — Example of "s" method analysis for combined control of double specification limits ($n \geqslant 5$): approximative method

Information needed	**Value obtained**
Size of initial sample: n	11
Upper specification limit: U	70 °C
Lower specification limit: L	60 °C
Mean of first sample: $\bar{x}_1$	64,46 °C
Standard deviation of first sample: s_1	2,877 °C
Factor for maximum of first sample standard deviation (from Table 16): $f_{s,1}$	0,293 4
Maximum acceptable first sample standard deviation: $s_{1,\max} = (U - L) f_{s,1} =$ (70 – 60) × 0,2934	2,934 °C
As $s_1 = 2{,}877 < s_{1,\max} = 2{,}934$, the lot *might* be acceptable, so the calculations are continued.	
Quality statistic for upper limit: $Q_{U,1} = (U - \bar{x}_1)/s_1 =$ (70 – 64,46) / 2,877	1,926
Quality statistic for lower limit: $Q_{L,1} = (\bar{x}_1 - L)/s_1 =$ (64,46 – 60,0) / 2,877	1,550
Step b of E.5 for upper limit: $v_{U,1} = \frac{1}{2}\left\{1 - Q_{U,1}\sqrt{n}/(n-1)\right\}$	0,180 6
Step b of E.5 for lower limit: $v_{L,1} = \frac{1}{2}\left\{1 - Q_{L,1}\sqrt{n}/(n-1)\right\}$	0,243 0
Constant from Table E.1: a_n	1,417 833
Step c of E.5 for upper limit: $y_{U,1} = a_n \ln\{v_{U,1}/(1 - v_{U,1})\}$	–2,144
Step d of E.5 for upper limit: $w_{U,1} = y_{U,1}^2 - 3$	1,597
Step e of E.5 for upper limit: $m = n - 1$	10
Step f of E.5 for upper limit: $w_{U,1} > 0$, so $t_{U,1} = 12 m y_{U,1}/(12m + w_{U,1})$	–2,116
Step g of E.5 for upper limit (from tables of the normal distribution function): $\hat{p}_{U,1} = \Phi(t_{U,1})$	0,017 2
Step c of E.5 for lower limit: $y_{L,1} = a_n \ln\{v_{L,1}/(1 - v_{L,1})\}$	–1,611
Step d of E.5 for lower limit: $w_{L,1} = y_{L,1}^2 - 3$	–0,404 7
Step e of E.5 for lower limit: $m = n - 1$	10
Step f of E.5 for lower limit: $w_L < 0$, so $t_{L,1} = 12(m-1) y_{L,1}/\{12(m-1) + w_{L,1}\}$	–1,617
Step g of E.5 for lower limit (from tables of the normal distribution function): $\hat{p}_{L,1} = \Phi(t_{L,1})$	0,052 9
Estimate of the total fraction nonconforming at first sample: $\hat{p}_1 = \hat{p}_{U,1} + \hat{p}_{L,1} =$ 0,017 2 + 0,052 9	0,070 1
Acceptability constant p_a^* (from Table 23)	0,017 50
Non-acceptability constant p_r^* (from Table 23)	0,069 94
As $\hat{p}_1 > p_r^*$ the lot is deemed to be non-acceptable without the need for a second sample.	

16.5 Form p^* acceptance procedure for the "s" method — Complex control of double specification limits

Complex control consists of combined control of both specification limits and simultaneous separate control of one of the limits using a separate and smaller AQL.

For example, suppose that the separate control applies to the lower specification limit, for which the required double samples are each of size n_L with acceptability constants $p^*_{L,\mathrm{a}}$, $p^*_{L,\mathrm{r}}$ and $p^*_{L,\mathrm{c}}$. Suppose that the required double sample sizes for combined control are each of size n with acceptability constants p^*_{a}, p^*_{r} and p^*_{c}. Select a random sample of a size that is the larger of n_L and n, noting the order of selection of the items. For the first n items selected, calculate the estimate $\hat{p}_{U,1}$ of the process fraction nonconforming at the upper specification limit, the estimate $\hat{p}_{L,1}$ of the process fraction nonconforming at the lower specification limit and their sum $\hat{p}_1 = \hat{p}_{U,1} + \hat{p}_{L,1}$. For the first n_L items selected, calculate the (second) estimate $\hat{p}^{(2)}_{L,1}$ of the process fraction nonconforming at the lower specification limit.

— If $\hat{p}_1 \leqslant p^*_{\mathrm{a}}$ and $\hat{p}^{(2)}_{L,1} \leqslant p^*_{L,\mathrm{a}}$, the lot is acceptable without drawing a second sample.

— If $\hat{p}_1 \geqslant p^*_{\mathrm{r}}$ or $\hat{p}^{(2)}_{L,1} \geqslant p^*_{L,\mathrm{r}}$, the lot is non-acceptable without drawing a second sample.

— If $p^*_{\mathrm{a}} < \hat{p}_1 < p^*_{\mathrm{r}}$ and $\hat{p}^{(2)}_{L,1} < p^*_{L,\mathrm{r}}$, or if $\hat{p}_1 < p^*_{\mathrm{r}}$ and $p^*_{L,\mathrm{a}} < \hat{p}^{(2)}_{L,1} < p^*_{L,\mathrm{r}}$, draw a second sample of the same size as the first. Calculate the estimate $\hat{p}_{\mathrm{c}}$ of the total process fraction nonconforming beyond both specification limits from the combined samples each of size n. Calculate the estimate $\hat{p}_{L,\mathrm{c}}$ of the process fraction nonconforming beyond the lower specification limit from the combined samples each of size n_L. If both $\hat{p}_{\mathrm{c}} \leqslant p^*_{\mathrm{c}}$ *and* $\hat{p}_{L,\mathrm{c}} \leqslant p^*_{L,\mathrm{c}}$, the lot is acceptable. Otherwise, the lot is non-acceptable.

— If $p^*_{\mathrm{a}} < \hat{p}_1 < p^*_{\mathrm{r}}$ and $\hat{p}^{(2)}_{L,1} < p^*_{L,\mathrm{a}}$, only the acceptability of the combined component of the complex control specification remains to be resolved. Draw a second sample of size n. Calculate the estimate $\hat{p}_{\mathrm{c}}$ of the total process fraction nonconforming beyond both specification limits from the combined samples each of size n. If $\hat{p}_{\mathrm{c}} \leqslant p^*_{\mathrm{c}}$, the lot is acceptable. Otherwise, the lot is non-acceptable.

— If $\hat{p}_1 < p^*_{\mathrm{a}}$ and $p^*_{L,\mathrm{a}} < \hat{p}^{(2)}_{L,1} < p^*_{L,\mathrm{r}}$, only the acceptability of the single specification limit component of the complex control specification remains to be resolved. Draw a second sample of size n_L. Calculate the estimate $\hat{p}_{L,\mathrm{c}}$ of the process fraction nonconforming beyond the lower specification limit from the combined samples each of size n_L. If $\hat{p}_{L,\mathrm{c}} \leqslant p^*_{L,\mathrm{c}}$, the lot is acceptable. Otherwise, the lot is non-acceptable.

NOTE 1 If $n_L = n$, $\hat{p}^{(2)}_{L,1}$ will be equal to $\hat{p}_{L,1}$.

NOTE 2 If the separate control applies to the upper specification limit, replace "L" by "U" and "lower" by "upper" in the foregoing text of this subclause.

17 Standard univariate "σ" method procedures

17.1 Obtaining a plan, sampling and preliminary calculations

The "σ" method shall only be used when, in the view of the responsible authority, there is sufficient evidence that the standard deviation of the process can be considered constant and taken to be σ.

For double specification limits, before sampling begins, determine the maximum process standard deviation (MPSD) as

$$\sigma_{\max} = (U - L) f_\sigma$$

where the factor f_σ is obtained

a) for combined control by entering Table 19 with the single AQL; or

b) for separate control by entering Table 20 with both AQLs; or

c) for complex control by entering Table 21 with both AQLs.

Compare the value of the process standard deviation σ with d_σ. If σ exceeds d_σ, the process is non-acceptable and sampling inspection is pointless until it is demonstrated that the process variability has been adequately reduced.

If, and only if, $\sigma \leqslant d_\sigma$, obtain the sample size code letter from Table 9. Then, depending on the severity of inspection and the type of control required (see following subclauses), and for each AQL, enter either

i) Table 13, 14 or 15 with the sample size code letter and the specified AQL to obtain the sample sizes n and acceptability constants k_a, k_r and k_c or

ii) Table 26, 27 or 28 with the sample size code letter and the specified AQL to obtain the sample sizes n and acceptability constants p_a^*, p_r^* and p_c^*.

Take an initial random sample of size n, measure the characteristic under inspection, x, for all items of the sample and calculate the mean $\bar{x}_1$. (The standard deviation, s_1, of the initial sample should also be calculated, but only for the purpose of checking the continued stability of the process standard deviation. See Clause **20**.)

It will be seen that the remaining steps are similar to those for the "s" method except that s_1 and s_c have been replaced by *σ.*

17.2 Form k acceptance procedure for the "σ" method — Single specification limit

17.2.1 General procedure

For a single specification limit, Form k is the simplest procedure to use. Calculate the quality statistic

$$Q_{U,1} = \frac{U - \bar{x}_1}{\sigma} \text{ or } Q_{L,1} = \frac{\bar{x}_1 - L}{\sigma}$$

as appropriate. If the quality statistic ($Q_{U,1}$ or $Q_{L,1}$ or) is greater than or equal to k_a then, without drawing a second random sample, the lot is acceptable. If the quality statistic is less than or equal to k_r, then, without drawing a second random sample, the lot is non-acceptable.

If the quality statistic lies between k_r and k_a, then draw a second random sample of the same size from the lot, and calculate its mean $\bar{x}_2$. Next, calculate the combined sample mean

$$\bar{x}_\text{c} = (\bar{x}_1 + \bar{x}_2)/2$$

and the combined quality statistic

$$Q_{U,\text{c}} = \frac{U - \bar{x}_\text{c}}{\sigma} \text{ or } Q_{L,\text{c}} = \frac{\bar{x}_\text{c} - L}{\sigma}$$

as appropriate. If the combined quality statistic is greater than or equal to k_c, then the lot is acceptable; otherwise, it is non-acceptable.

Thus, if only the upper specification limit U is given, the lot is

acceptable if $Q_{U,1} \geqslant k_\text{a}$, or if $k_\text{r} < Q_{U,1} < k_\text{a}$ and $Q_{U,\text{c}} \geqslant k_\text{c}$; or

non-acceptable if $Q_{U,1} \leqslant k_\text{r}$, or if $k_\text{r} < Q_{U,1} < k_\text{a}$ and $Q_{U,\text{c}} < k_\text{c}$;

or, if only the lower specification limit L is given, the lot is

acceptable if $Q_{L,1} \geqslant k_a$, or if $k_r < Q_{L,1} < k_a$ and $Q_{L,c} \geqslant k_c$; or

non-acceptable if $Q_{L,1} \leqslant k_r$, or if $k_r < Q_{L,1} < k_a$ and $Q_{L,c} < k_c$.

17.2.2 Simplified general procedure

Note that, for an upper specification limit, the acceptability criteria may be written as inequalities on $\bar{x}$, i.e. the lot is

acceptable if $\bar{x}_1 \leqslant U - k_a\sigma$, or if $U - k_r\sigma < \bar{x}_1 < U - k_a\sigma$ and $\bar{x}_c \leqslant U - k_c\sigma$; or

non-acceptable if $\bar{x}_1 \geqslant U - k_r\sigma$, or $U - k_a\sigma < \bar{x}_1 < U - k_r\sigma$ and $\bar{x}_c > U - k_c\sigma$.

As U, k_a, k_r, k_c and σ are all known in advance, the values of $x_{U,a}[= U - k_a\sigma]$, $x_{U,r}[= U - k_r\sigma]$ and $x_{U,c}[= U - k_c\sigma]$ should therefore be determined before inspection begins, in order to avoid the need to calculate the values of quality statistics. For a single, upper specification limit, a lot will be

acceptable if $\bar{x}_1 \leqslant x_{U,a}$, or if $x_{U,a} < \bar{x}_1 < x_{U,r}$ and $\bar{x}_c \leqslant x_{U,c}$; or

non-acceptable if $\bar{x}_1 \geqslant x_{U,r}$, or if $x_{U,a} < \bar{x}_1 < x_{U,r}$ and $\bar{x}_c > x_{U,c}$.

Similarly, for a single, lower specification limit, the values of $x_{L,a}[= L + k_a\sigma]$, $x_{L,r}[= L + k_r\sigma]$ and $x_{L,c}[= L + k_c\sigma]$ should be determined in advance. A lot will be

acceptable if $\bar{x}_1 \geqslant x_{L,a}$, or if $x_{L,r} < \bar{x}_1 < x_{L,a}$ and $\bar{x}_c \geqslant x_{L,c}$; or

non-acceptable if $\bar{x}_1 \leqslant x_{L,r}$, or $x_{L,r} < \bar{x}_1 < x_{L,a}$ and $\bar{x}_c < x_{L,c}$.

EXAMPLE

"σ" method, single specification limit

The specified minimum yield point for certain steel castings is 400 N/mm^2. Lots of 500 items are submitted for inspection. Inspection level II, normal inspection, with AQL =1,5 %, is to be used. The value of σ is considered to be 21 N/mm^2.

From Table 9, it is seen that the sample size code letter is H. Then, from Table 13, it is seen that for an AQL of 1,5 % the sample size n is 8 and the Form k acceptability constants are $k_a = 1{,}776$, $k_r = 1{,}357$ and $k_c = 1{,}638$. Suppose the yield points in N/mm^2 of the 8 sample specimens from the initial sample from the current lot are 431, 417, 469, 407, 442, 452, 427 and 411. Conformance to the acceptability criterion is to be determined. The analysis is given in Table 7.

Table 7 — Example of "σ" method analysis for a lower specification limit

Information needed	Value obtained
Sample size: n	8
Acceptability constant at the first sample: k_a	1,776
Non-acceptability constant at the first sample: k_r	1,357
Presumed value of the process standard deviation: σ	21 N/mm^2
Lower specification limit: L	400 N/mm^2
Acceptance value for the first sample: $x_{L,\text{a}} = L + k_\text{a}\sigma$	437,3 N/mm^2
Non-acceptance value for the first sample: $x_{L,\text{r}} = L + k_\text{r}\sigma$	428,5 N/mm^2
Sum of measurements for the first sample: Σx_1	3 464 N/mm^2
Mean of first sample: $\bar{x}_1$	433,0 N/mm^2
Initial acceptance test: Is $\bar{x}_1 \geqslant x_{L,\text{a}}$?	No
The lot does not meet the initial acceptability criterion, so we test to see if it satisfies the non-acceptability criterion.	
Initial non-acceptance test: $\bar{x}_1 \leqslant x_{L,\text{r}}$	No
The lot does not meet the initial non-acceptability criterion either, so a second sample of 8 items is drawn. Suppose the yield points in N/mm^2 of the second sample are 439, 422, 415, 425, 432, 430, 410 and 428.	
Acceptability constant for the combined first and second samples: k_c	1,638
Acceptance value for the combined samples: $x_{L,\text{c}} = L + k_\text{c}\sigma$	434,4 N/mm^2
Sum of measurements for the second sample: Σx_2	3 456 N/mm^2
Mean of second sample: $\bar{x}_2$	432,0 N/mm^2
Combined mean: $\bar{x}_\text{c} = (\bar{x}_1 + \bar{x}_2)/2$	432,5 N/mm^2
Combined acceptance test: Is $\bar{x}_\text{c} \geqslant x_{L,\text{c}}$?	No
The lot fails the combined acceptance test and so the lot is non-accepted.	

NOTE This is another example in which the lot is non-accepted despite no nonconforming items being found in either sample.

17.3 Form k acceptance procedure for the "σ" method — Separate control of double specification limits

For double specification limits with separate control, the lot may at once be declared to be non-acceptable if σ is greater than the MPSD derived from Table 20. If $\sigma \leqslant$ MPSD, enter Table 13, 14 or 15 as appropriate with the sample size code letter and the AQL for the upper specification limit to determine the sample size n_U and the relevant acceptability constants $k_{U,\text{a}}$, $k_{U,\text{r}}$ and $k_{U,\text{c}}$; repeat for the lower specification limit to determine the sample size n_L and the relevant acceptability constants $k_{L,\text{a}}$, $k_{L,\text{r}}$ and $k_{L,\text{c}}$. Denote the larger of n_U and n_L by n. Randomly select a sample of size n from the lot, with the order of selection recorded. Compute $\bar{x}_{U,1}$ from the measurements of the first n_U items selected and $\bar{x}_{L,1}$ from the first n_L items selected. The lot will be acceptable if

$$\bar{x}_{U,1} \leqslant x_{U,\text{a}} \left[= U - k_{U,\text{a}}\sigma\right] \text{ and } \bar{x}_{L,1} \geqslant x_{L,\text{a}} \left[= L + k_{L,\text{a}}\sigma\right],$$

and non-acceptable if

$$\bar{x}_{U,1} \geqslant x_{U,\text{r}} \left[= U - k_{U,\text{r}}\sigma\right] \text{ and/or } \bar{x}_{L,1} \leqslant x_{L,\text{r}} \left[= L + k_{L,\text{r}}\sigma\right].$$

If $x_{U,\text{a}} < \bar{x}_{U,1} < x_{U,\text{r}}$ and $x_{L,\text{r}} < \bar{x}_{L,1} < x_{L,\text{a}}$, select a second random sample of the same size and in the same way as the first sample from the lot, measure the quality characteristic on each item and calculate the sample means $\bar{x}_{U,2}$ and $\bar{x}_{L,2}$. Then calculate the combined sample means $\bar{x}_{U,\text{c}} = (\bar{x}_{U,1} + \bar{x}_{U,2})/2$ and $\bar{x}_{L,\text{c}} = (\bar{x}_{L,1} + \bar{x}_{L,2})/2$. If both $\bar{x}_{U,\text{c}} \leqslant x_{U,\text{c}}$ $[= U - k_{U,\text{c}}\sigma]$ and $\bar{x}_{L,\text{c}} \geqslant x_{L,\text{c}}$ $[= L + k_{L,\text{c}}\sigma]$, the lot is acceptable; otherwise, it is non-acceptable.

Alternatively, if $x_{U,\text{a}} < \bar{x}_{U,1} < x_{U,\text{r}}$ but $\bar{x}_{L,1} \geqslant x_{L,\text{a}}$, control at the lower specification limit may be deemed to be acceptable but further information is required relating to the upper limit. Select a second sample of size n_U and determine $\bar{x}_{U,2}$ and $\bar{x}_{U,\text{c}}$. The lot is acceptable if $\bar{x}_{U,\text{c}} \leqslant x_{U,\text{c}}[= U - k_{U,\text{c}}\sigma]$; otherwise, it is non-acceptable.

The final possibility is that $x_{L,\text{r}} < \bar{x}_{L,1} < x_{L,\text{a}}$ but $\bar{x}_{U,1} \leqslant x_{U,\text{a}}$. Here, further information is required relating to the lower specification limit before a decision as to acceptability can be made. Select a second sample of size n_L and determine $\bar{x}_{L,2}$ and $\bar{x}_{L,\text{c}}$. The lot is acceptable if $\bar{x}_{L,\text{c}} \geqslant x_{L,\text{c}}$ $[= L + k_{L,\text{c}}\sigma]$; otherwise, it is non-acceptable.

17.4 Form p* acceptance procedure for the "σ" method — Combined control of double specification limits

If there is a combined AQL requirement for the upper and the lower specification limits, i.e. one overall AQL for the percentage of the process outside both specification limits, the following procedure is recommended.

a) Before sampling, determine the value of the factor f_σ by entering Table 19 with the AQL. Calculate the maximum allowable value σ_{max} of the process standard deviation (the MPSD) from the formula $\sigma_{\text{max}} = (U - L) f_\sigma$.

b) Compare the value of the process standard deviation σ with σ_{max}. If σ exceeds σ_{max}, the process is non-acceptable and sampling inspection is pointless until it is demonstrated that the process variability has been adequately reduced.

c) If $\sigma \leqslant \sigma_{\text{max}}$, then use the lot size and given inspection level to determine the sample size code letter from Table 9.

d) From the sample size code letter and inspection severity (i.e. whether inspection is normal, tightened or reduced), determine the sample sizes, n, and acceptability constants, p_a^*, p_r^* and p_c^*, from Table 26, 27 or 28.

e) Select an initial random sample of size n from the lot and calculate the initial sample mean $\bar{x}_1$.

f) Calculate the quality statistics $Q_{U,1} = (U - \bar{x}_1)/\sigma$ and $Q_{L,1} = (\bar{x}_1 - L)/\sigma$.

g) Using the method described in **E.3.2**, calculate $\hat{p}_{U,1}$, $\hat{p}_{L,1}$ and $\hat{p}_1 = \hat{p}_{U,1} + \hat{p}_{L,1}$.

h) If $\hat{p}_1 \leqslant p_\text{a}^*$, the lot is acceptable and no further samples, calculations or comparisons are required.

i) If $\hat{p}_1 \geqslant p_\text{r}^*$, the lot is non-acceptable and no further samples, calculations or comparisons are required.

j) If $p_\text{a}^* < \hat{p}_1 < p_\text{r}^*$, select a second random sample of size n and calculate the second sample mean $\bar{x}_2$ and the combined sample mean $\bar{x}_\text{c}$.

k) Calculate the combined quality statistics $Q_{U,\text{c}} = (U - \bar{x}_\text{c})/\sigma$ and $Q_{L,\text{c}} = (\bar{x}_\text{c} - L)/\sigma$.

l) Using the method described in **E.4.2**, calculate $\hat{p}_{U,\text{c}}$, $\hat{p}_{L,\text{c}}$ and $\hat{p}_\text{c} = \hat{p}_{U,\text{c}} + \hat{p}_{L,\text{c}}$.

m) If $\hat{p}_\text{c} \leqslant p_\text{c}^*$, the lot is acceptable; otherwise, it is non-acceptable.

EXAMPLE

"σ" method, double specification limits, combined control

The specification for electrical resistance of a certain electrical component is 520 Ω ± 50 Ω. Production is at a rate of 2 500 items per inspection lot. Inspection level II, normal inspection, with a single AQL of 4 %, is to be used for the two specification limits (470 Ω and 570 Ω). σ is known to be 21,0 Ω.

The factor for the MPSD is found from Table 19 to be 0,223, so the MPSD is $\sigma_{\text{max}} = (U - L) f_\sigma = 22{,}3$ Ω. As $\sigma < \sigma_{\text{max}}$, it is possible for lots to be acceptable. Entering Table 9 with the lot size and inspection level, it is found that the sample size code letter is K; from Table 26, it is seen that a sample size of 21 is required under normal inspection. Suppose the values of the sample resistance in ohms in the initial sample are as follows: 515, 491, 479, 507, 543, 521, 536, 483, 509, 548, 514, 507, 484, 526, 552, 499, 530, 492, 533, 512 and 492. Lot acceptability is to be determined. Table 8 shows the analysis.

Table 8 — Example of "σ" method analysis for combined control of double specification limits

Information needed	Value obtained
Sample size: n	21
Form $p*$ acceptability constant at the first sample: p_{a}^*	0,069 57
Form $p*$ non-acceptability constant at the first sample: p_{r}^*	0,107 0
Presumed value of the process standard deviation: σ	21,0 Ω
Upper specification limit: U	570 Ω
Lower specification limit: L	470 Ω
Sum of measurements for the first sample: Σx_1	10 773 Ω
Mean of first sample: $\bar{x}_1$	513 Ω
Quality statistic at U for first sample: $Q_{U,1} = (U - \bar{x}_1)/\sigma$	2,714
Quality statistic at L for first sample: $Q_{L,1} = (\bar{x}_1 - L)/\sigma$	2,048
$-Q_{U,1}\sqrt{n/(n-1)}$	– 2,781
Estimate of the process fraction nonconforming at U for first sample: $\hat{p}_{U,1} = \Phi\left(-Q_{U,1}\sqrt{n/(n-1)}\right)$	0,002 71
$-Q_{L,1}\sqrt{n/(n-1)}$	– 2,099
Estimate of the process fraction nonconforming at L for first sample: $\hat{p}_{L,1} = \Phi\left(-Q_{L,1}\sqrt{n/(n-1)}\right)$	0,017 91
Total estimate of process fraction nonconforming for first sample: $\hat{p}_1 = \hat{p}_{U,1} + \hat{p}_{L,1}$	0,020 62
As $\hat{p}_1 < p_{\text{a}}^*$, the lot is immediately judged to be acceptable.	

NOTE If, for example, σ had been known to be 25, then σ exceeds the MPSD and therefore sampling inspection should not have taken place until sufficient evidence had been provided that σ had been reduced below 22,3 Ω.

17.5 Form $p*$ acceptance procedure for the "σ" method — Complex control of double specification limits

Complex control of double specification limits is a combination of combined control on both limits with one AQL and control of the specification of the more serious nature with a lower AQL. For complex control, the following procedure is recommended. For brevity of exposition, the more serious specification limit is assumed to be the lower limit; it will be evident what changes to make when the upper limit is the more serious.

a) Before sampling, determine the value of the factor f_σ by entering Table 21 with both AQLs.

b) Calculate the maximum allowable value of the process standard deviation, using the formula MPSD $= \sigma_{\max} = (U - L) f_\sigma$.

c) Compare the value of the process standard deviation σ with the MPSD $\sigma_{\max}$. If σ exceeds $\sigma_{\max}$, the process is non-acceptable and sampling inspection is pointless until it is demonstrated that the process variability has been adequately reduced.

d) If $\sigma \leqslant \sigma_{\max}$, then use the lot size and given inspection level to determine the sample size code letter from Table 9.

e) From the sample size code letter, inspection severity (i.e. whether inspection is normal, tightened or reduced) and AQL for the combined component of the control, determine the sample sizes, n, and acceptability constants, p_a^*, p_r^* and p_c^*, from Table 26, 27 or 28.

f) From the sample size code letter, inspection severity and AQL for the lower specification limit, determine the sample sizes, n_L and acceptability constants, $p_{L,\mathrm{a}}^*$, $p_{L,\mathrm{r}}^*$ and $p_{L,\mathrm{c}}^*$, from Table 26, 27 or 28.

g) Select an initial random sample of a size that is the larger of n and n_L from the lot, identifying the order of selection of the items, and calculate the sample mean $\bar{x}_1$ from the first n items and the sample mean $\bar{x}_1^{(2)}$ from the first n_L items.

h) Calculate the quality statistics $Q_{U,1} = (U - \bar{x}_1)/\sigma$, $Q_{L,1} = (\bar{x}_1 - L)/\sigma$ and $Q_{L,1}^{(2)} = (\bar{x}_1^{(2)} - L)/\sigma$.

i) Using the formulae in **E.3.2**, calculate $\hat{p}_{U,1}$ from $Q_{U,1}$, $\hat{p}_{L,1}$ from $Q_{L,1}$ and $\hat{p}_{L,1}^{(2)}$ from $Q_{L,1}^{(2)}$.

j) Calculate $\hat{p}_1 = \hat{p}_{U,1} + \hat{p}_{L,1}$.

k) If $\hat{p}_1 \leqslant p_\mathrm{a}^*$ and $\hat{p}_{L,1}^{(2)} \leqslant p_{L,\mathrm{a}}^*$, the lot is acceptable and no further sampling is required.

l) If $\hat{p}_1 \geqslant p_\mathrm{r}^*$ or $\hat{p}_{L,1}^{(2)} \geqslant p_{L,\mathrm{r}}^*$, the lot is non-acceptable and no further sampling is required.

m) If $p_\mathrm{a}^* < \hat{p}_1 < p_\mathrm{r}^*$ and $p_{L,\mathrm{a}}^* < \hat{p}_{L,1}^{(2)} < p_{L,\mathrm{r}}^*$, then draw a second sample of the same size as the first from the lot, again identifying the order of selection. Calculate the sample mean $\bar{x}_2$ from the first n items of this sample and the sample mean $\bar{x}_2^{(2)}$ from the first n_L items. Calculate the combined means $\bar{x}_\mathrm{c} = (\bar{x}_1 + \bar{x}_2)/2$ and $\bar{x}_\mathrm{c}^{(2)} = (\bar{x}_1^{(2)} + \bar{x}_2^{(2)})/2$. Calculate the quality statistics $Q_{U,\mathrm{c}} = (U - \bar{x}_\mathrm{c})/\sigma$, $Q_{L,\mathrm{c}} = (\bar{x}_\mathrm{c} - L)/\sigma$ and $Q_{L,\mathrm{c}}^{(2)} = (\bar{x}_\mathrm{c}^{(2)} - L)/\sigma$. From the formulae in **E.4.2**, calculate $\hat{p}_{U,\mathrm{c}}$ from $Q_{U,\mathrm{c}}$, $\hat{p}_{L,\mathrm{c}}$ from $Q_{L,\mathrm{c}}$ and $\hat{p}_{L,\mathrm{c}}^{(2)}$ from $Q_{L,\mathrm{c}}^{(2)}$. Calculate $\hat{p}_\mathrm{c} = \hat{p}_{U,\mathrm{c}} + \hat{p}_{L,\mathrm{c}}$. If $\hat{p}_\mathrm{c} \leqslant p_\mathrm{c}^*$ and $\hat{p}_{L,\mathrm{c}}^{(2)} \leqslant p_{L,\mathrm{c}}^*$, the lot is acceptable. Otherwise, the lot is non-acceptable.

n) If $p_\mathrm{a}^* < \hat{p}_1 < p_\mathrm{r}^*$ and $\hat{p}_{L,1}^{(2)} \leqslant p_{L,\mathrm{a}}^*$, only the acceptability of the combined component of the complex control specification remains to be resolved. Draw a second sample of size n, calculate its mean $\bar{x}_2$ and the combined mean $\bar{x}_\mathrm{c} = (\bar{x}_1 + \bar{x}_2)/2$. Calculate the quality statistics $Q_{U,\mathrm{c}} = (U - \bar{x}_\mathrm{c})/\sigma$ and $Q_{L,\mathrm{c}} = (\bar{x}_\mathrm{c} - L)/\sigma$. From the formulae in **E.4.2**, calculate $\hat{p}_{U,\mathrm{c}}$ from $Q_{U,\mathrm{c}}$ and $\hat{p}_{L,\mathrm{c}}$ from $Q_{L,\mathrm{c}}$. Calculate $\hat{p}_\mathrm{c} = \hat{p}_{U,\mathrm{c}} + \hat{p}_{L,\mathrm{c}}$. If $\hat{p}_\mathrm{c} \leqslant p_\mathrm{c}^*$, the lot is acceptable. Otherwise, the lot is non-acceptable.

o) If $\hat{p}_1 \leqslant p_\mathrm{a}^*$ and $p_{L,\mathrm{a}}^* < \hat{p}_{L,1}^{(2)} < p_{L,\mathrm{r}}^*$, only the acceptability of the component of the complex control specification relating to the lower specification limit remains to be resolved. Draw a second sample of size n_L and calculate its mean $\bar{x}_2^{(2)}$ and the combined mean $\bar{x}_\mathrm{c}^{(2)} = (\bar{x}_1^{(2)} + \bar{x}_2^{(2)})/2$. Calculate the quality statistic $Q_{L,\mathrm{c}}^{(2)} = (\bar{x}_\mathrm{c}^{(2)} - L)/\sigma$. Calculate $\hat{p}_{L,\mathrm{c}}^{(2)}$ from $Q_{L,\mathrm{c}}^{(2)}$ in accordance with **E.4.2**. If $\hat{p}_{L,\mathrm{c}}^{(2)} \leqslant p_{L,\mathrm{c}}^*$, the lot is acceptable. Otherwise, the lot is non-acceptable.

18 Procedure during continuing inspection

As a variables sampling inspection plan can only operate efficiently if

a) the characteristic being inspected is normally distributed,

b) records are kept, and

c) the switching rules are obeyed,

it is necessary to ensure that these requirements are being met.

19 Normality and outliers

19.1 Normality

The responsible authority should have checked for normality before sampling began. In the case of doubt, a statistician should advise whether the distribution appears suitable for sampling by variables, or whether use should be made of the tests for departure from normality given, for example, in ISO 5479.

19.2 Outliers

An outlier (or an outlying observation) is one that appears to deviate markedly from other observations in the sample in which it occurs. A single outlier, even when it lies within specification limits, will produce an increase in variability and change the mean and can consequently lead to non-acceptance of the lot. (See, for example, ISO 5725-2.) When outliers are detected but the lot still meets the acceptance criteria, the disposition of the lot should be a matter for negotiation between the vendor and vendee.

20 Records

20.1 Control charts

One of the advantages of inspection by variables is that trends in the quality level of the product can be detected and a warning given before a non-acceptable standard is reached, but this is only possible if adequate records are kept.

Whatever the method used, "s" or "σ", records should be kept of the values of $\bar{x}$ and s, preferably in the form of control charts. (See, for example, ISO 7870 and ISO 8258.)

This procedure should be applied especially with the "σ" method in order to verify that the values of s obtained from the samples fall within the limits of the prescribed value of σ.

For double specification limits with a combined AQL requirement, the value of the MSSD, given in Table 16, 17 or 18, should be identified on the s control chart, as an indication of a non-acceptable value.

NOTE Control charts are used to detect trends. The ultimate decision as to the acceptability of an individual lot is governed by the procedures given in Clauses **15** to **19**.

20.2 Lots that are non-accepted

Particular care shall be taken to record all lots that are non-accepted and to see that switching rules are implemented. Any lot non-accepted by the sampling plan should not be resubmitted either in whole or in part without the permission of the responsible authority.

21 Operation of switching rules

The standard switching rules are given below.

21.1 Normal inspection shall be used at the start of inspection (unless otherwise designated) and shall continue to be used during the course of inspection until tightened inspection becomes necessary or reduced inspection is allowed.

21.2 Tightened inspection shall be instituted when two lots on original normal inspection are non-accepted within any five or fewer successive lots.

21.3 Tightened inspection is generally achieved by increasing the values of the acceptability constant. The values of n and k are tabulated in Table 11 for the "s" method and Table 14 for the "σ" method; the corresponding values of n and p^* are given in Table 24 for the "s" method and Table 27 for the "σ" method.

Tightened inspection shall be relaxed when five successive lots on original inspection have been accepted on tightened inspection; then normal inspection shall be reinstated.

21.4 Reduced inspection may be instituted after ten successive lots have been accepted under normal inspection, provided that:

a) none of these lots required the second sample to be selected;

b) production is in statistical control;

c) reduced inspection is considered desirable by the responsible authority.

Reduced inspection is conducted on a much smaller sample than normal inspection and the value of the acceptability constant is also decreased. The values of n and k for reduced inspection are given in Table 12 for the "s" method and Table 15 for the "σ" method; the corresponding values of n and p^* are given in Table 25 for the "s" method and Table 28 for the "σ" method.

Reduced inspection shall cease and normal inspection shall be reinstated if any of the following occur on original inspection:

i) a lot is non-accepted;

ii) production becomes irregular or delayed;

iii) reduced inspection is no longer considered desirable by the responsible authority.

22 Discontinuation and resumption of inspection

If the cumulative number of lots non-accepted in a sequence of consecutive lots on original tightened inspection reaches five, the acceptance procedures of this part of ISO 3951 should be discontinued.

Inspection under the provisions of this part of ISO 3951 should not be resumed until action has been taken by the supplier to improve the quality of the submitted product or service. Tightened inspection shall then be used as if **21.3** had been invoked.

23 Switching between the "s" and "σ" methods

23.1 Estimating the process standard deviation

While this part of ISO 3951 is being used, the weighted root mean square of the values of s shall be calculated periodically as estimates of the process standard deviation σ, for both the "s" and the "σ" methods. The value of σ shall be estimated at five-lot intervals, unless the responsible authority specifies another interval. The estimate shall be based on the preceding ten lots, unless the responsible authority specifies another number of lots.

23.2 State of statistical control of within-sample variability

Calculate the upper control limit for each of the ten lots (or other number of lots specified by the responsible authority) from the expression $c_u\sigma$, where c_u is a factor which depends on the sample size n and is given in Table 29. If none of the sample standard deviations s_i exceeds the corresponding control limit, then the process variability may be considered to be in a state of statistical control; otherwise the process variability should be considered to be out of statistical control.

NOTE 1 If the sample sizes from the lots are all equal, then the value of $c_u\sigma$ is common to all the lots.

NOTE 2 If the sample sizes from each lot vary, it is not necessary to calculate $c_u\sigma$ for those lots for which the sample standard deviation s_i is less than or equal to σ.

NOTE 3 ISO 7870 provides guidance on the use of control charts.

23.3 Switching from the "s" method to the "σ" method

If the process is considered to be in a state of statistical control under the "s" method, then the "σ" method may be instituted using the latest value of σ.

NOTE This switch is made at the discretion of the responsible authority.

23.4 Switching from the "σ" method to the "s" method

It is recommended that a control chart for s be kept even under the "σ" method. As soon as the process is considered to be out of statistical control, inspection shall be switched to the "s" method.

Table 9 — Sample size code letters and inspection levels

Lot or batch size	Special inspection levels				General inspection levels		
	S-1	S-2	S-3	S-4	I	II	III
2 to 8	B	B	B	B	B	B	B
9 to 15	B	B	B	B	B	B	C
16 to 25	B	B	B	B	B	C	D
26 to 50	B	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

NOTE The sample size code letters and inspection levels in this part of ISO 3951 correspond to those given in ISO 2859-1, ISO 3951-1 and ISO 3951-2.

Table 10 — Form *k* double sampling plans for normal inspection (master table) — "*s*" method

Sample size code letter	Acceptance quality limit (in percent nonconforming)															
	0,01	0,015	0,025	0,04	0,065	0,10	0,15	0,25	0,40	0,65	1,0	1,5	2,5	4,0	6,5	10,0
	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c
B	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	**3, 0**	**3, ⅓**	**3, ½**
C	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	3 1,696 0,908 1,328	4 1,342 0,712 1,155	4 1,242 0,627 1,006	3 0,928 0,249 0,568
D	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	4 1,891 1,153 1,556	6 1,587 1,020 1,397	6 1,496 0,944 1,271	4 1,199 0,590 0,944	4 0,786 0,199 0,536
E	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	6 2,113 1,446 1,714	9 1,825 1,310 1,617	9 1,740 1,238 1,506	6 1,467 0,920 1,239	6 1,109 0,609 0,914	6 0,843 0,361 0,656
F	↓	↓	↓	↓	↓	↓	↓	↓	↓	8 2,291 1,666 1,872	11 2,001 1,501 1,824	11 1,921 1,432 1,727	8 1,677 1,160 1,476	9 1,367 0,919 1,182	9 1,133 0,711 0,969	8 0,764 0,345 0,639
G	↓	↓	↓	↓	↓	↓	↓	↓	10 2,463 1,863 2,067	14 2,188 1,709 2,025	15 2,122 1,666 1,925	12 1,907 1,439 1,684	13 1,613 1,200 1,442	13 1,401 1,014 1,262	13 1,094 0,738 0,981	13 0,862 0,523 0,757
H	↓	↓	↓	↓	↓	↓	↓	12 2,616 2,035 2,348	18 2,362 1,908 2,196	19 2,297 1,861 2,108	15 2,090 1,638 1,892	17 1,820 1,426 1,668	18 1,630 1,269 1,503	20 1,363 1,046 1,253	20 1,159 0,859 1,064	20 0,918 0,636 0,833
J	↓	↓	↓	↓	↓	↓	15 2,778 2,224 2,409	23 2,536 2,105 2,365	24 2,471 2,056 2,287	20 2,281 1,857 2,081	23 2,026 1,657 1,880	25 1,851 1,515 1,731	28 1,607 1,311 1,509	30 1,428 1,157 1,342	31 1,219 0,969 1,143	32 1,002 0,770 0,932
K	↓	↓	↓	↓	↓	18 2,923 2,389 2,562	28 2,689 2,276 2,522	29 2,626 2,226 2,450	25 2,448 2,043 2,254	30 2,209 1,861 2,066	33 2,045 1,728 1,929	39 1,821 1,547 1,725	42 1,656 1,405 1,575	45 1,469 1,239 1,399	48 1,277 1,068 1,214	49 1,019 0,827 0,964
L	↓	↓	↓	↓	22 3,073 2,563 2,705	33 2,840 2,439 2,684	36 2,786 2,405 2,608	31 2,614 2,227 2,427	38 2,388 2,057 2,250	43 2,235 1,935 2,123	51 2,024 1,764 1,936	57 1,874 1,638 1,798	64 1,704 1,493 1,638	69 1,531 1,339 1,474	75 1,306 1,133 1,255	↑
M	↓	↓	↓	26 3,209 2,718 2,846	39 2,983 2,595 2,830	42 2,928 2,558 2,765	37 2,765 2,391 2,586	47 2,552 2,235 2,418	54 2,406 2,121 2,299	66 2,208 1,963 2,124	75 2,068 1,847 1,996	86 1,911 1,714 1,849	96 1,753 1,575 1,699	107 1,549 1,390 1,503	↑	↑
N	↓	↓	30 3,341 2,863 2,991	46 3,123 2,748 2,972	50 3,071 2,715 2,905	45 2,915 2,557 2,738	57 2,709 2,405 2,581	67 2,572 2,300 2,467	83 2,384 2,151 2,303	96 2,252 2,043 2,184	112 2,106 1,919 2,047	128 1,959 1,792 1,909	148 1,772 1,625 1,729	↑	↑	↑
P	↓	35 3,472 3,011 3,125	54 3,260 2,899 3,111	59 3,211 2,867 3,047	53 3,059 2,713 2,888	68 2,861 2,568 2,738	82 2,731 2,472 2,630	103 2,553 2,330 2,475	122 2,429 2,231 2,362	144 2,291 2,115 2,234	166 2,153 1,996 2,106	198 1,980 1,843 1,940	↑	↑	↑	↑
Q	41 3,596 3,153 3,242	62 3,386 3,035 3,238	68 3,338 3,005 3,177	62 3,192 2,858 3,023	81 3,002 2,720 2,880	97 2,875 2,625 2,777	125 2,705 2,493 2,630	147 2,586 2,395 2,523	178 2,456 2,288 2,402	209 2,326 2,177 2,281	254 2,164 2,034 2,125	↑	↑	↑	↑	↑
R	71 3,514 3,173 3,368	78 3,467 3,144 3,309	71 3,325 3,000 3,162	94 3,141 2,868 3,025	115 3,021 2,780 2,926	149 2,858 2,653 2,785	179 2,745 2,563 2,684	218 2,620 2,460 2,569	260 2,498 2,356 2,454	322 2,345 2,222 2,308	↑	↑	↑	↑	↑	↑

NOTE 1 The sample size code letters in this part of ISO 3951 correspond to those given in ISO 2859-1, ISO 3951-1 and ISO 3951-2.

NOTE 2 Symbols: ↓ There is no suitable plan in this area; use the first sampling plan below the arrow. If the sample size equals or exceeds the lot size, carry out 100 % inspection.
↑ There is no suitable plan in this area; use the first sampling plan above the arrow.

NOTE 3 Numbers in boldface type indicate single sampling plan by attributes of the form n, Ac. If Ac is a fraction, a lot is acceptable if 1/Ac consecutive lots including the present one contain no more than one nonconforming item in total.

Table 11 — Form k double sampling plans for tightened inspection (master table) — "s" method

Sample size code letter	Acceptance quality limit (in percent nonconforming)															
	0,01	0,015	0,025	0,04	0,065	0,10	0,15	0,25	0,40	0,65	1,0	1,5	2,5	4,0	6,5	10,0
	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c
B	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	**3, 0**	**3, ⅓**
C	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	3 1,696 0,908 1,328	4 1,342 0,712 1,155	4 1,242 0,627 1,006
D	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	4 1,891 1,153 1,556	6 1,587 1,020 1,397	6 1,496 0,944 1,271	4 1,199 0,590 0,944
E	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	6 2,113 1,446 1,714	9 1,825 1,310 1,617	9 1,740 1,238 1,506	6 1,467 0,920 1,239	6 1,109 0,609 0,914
F	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	8 2,291 1,666 1,872	11 2,001 1,501 1,824	11 1,921 1,432 1,727	8 1,677 1,160 1,476	9 1,367 0,919 1,182	9 1,133 0,711 0,969
G	↓	↓	↓	↓	↓	↓	↓	↓	↓	10 2,463 1,863 2,067	14 2,188 1,709 2,025	15 2,122 1,666 1,925	12 1,907 1,439 1,684	13 1,613 1,200 1,442	13 1,401 1,014 1,262	13 1,094 0,738 0,981
H	↓	↓	↓	↓	↓	↓	↓	↓	12 2,616 2,035 2,348	18 2,362 1,908 2,196	19 2,297 1,861 2,108	15 2,090 1,638 1,892	17 1,820 1,426 1,668	18 1,630 1,269 1,503	20 1,363 1,046 1,253	20 1,072 0,779 0,982
J	↓	↓	↓	↓	↓	↓	↓	15 2,778 2,224 2,409	23 2,536 2,105 2,365	24 2,471 2,056 2,287	20 2,281 1,857 2,081	23 2,026 1,657 1,880	25 1,851 1,515 1,731	28 1,607 1,311 1,509	31 1,354 1,093 1,269	32 1,105 0,867 1,032
K	↓	↓	↓	↓	↓	↓	18 2,923 2,389 2,562	28 2,689 2,276 2,522	29 2,626 2,226 2,450	25 2,448 2,043 2,254	30 2,209 1,861 2,066	33 2,045 1,728 1,929	39 1,821 1,547 1,725	43 1,587 1,344 1,511	47 1,368 1,150 1,301	49 1,121 0,924 1,063
L	↓	↓	↓	↓	↓	22 3,073 2,563 2,705	33 2,840 2,439 2,684	36 2,786 2,405 2,608	31 2,614 2,227 2,427	38 2,388 2,057 2,250	43 2,235 1,935 2,123	51 2,024 1,764 1,936	60 1,812 1,587 1,740	67 1,612 1,412 1,551	73 1,394 1,215 1,341	↑
M	↓	↓	↓	↓	26 3,209 2,718 2,846	39 2,983 2,595 2,830	42 2,928 2,558 2,765	37 2,765 2,391 2,586	47 2,552 2,235 2,418	54 2,406 2,121 2,299	66 2,208 1,963 2,124	79 2,011 1,798 1,942	91 1,827 1,639 1,769	103 1,629 1,463 1,579	↑	↑
N	↓	↓	↓	30 3,341 2,863 2,991	46 3,123 2,748 2,972	50 3,071 2,715 2,905	45 2,915 2,557 2,738	57 2,709 2,405 2,581	67 2,572 2,300 2,467	83 2,384 2,151 2,303	102 2,198 1,998 2,134	121 2,028 1,852 1,973	140 1,845 1,690 1,799	↑	↑	↑
P	↓	↓	35 3,472 3,011 3,125	54 3,260 2,899 3,111	59 3,211 2,867 3,047	53 3,059 2,713 2,888	68 2,861 2,568 2,738	82 2,731 2,472 2,630	103 2,553 2,330 2,475	129 2,377 2,187 2,316	155 2,217 2,051 2,166	185 2,047 1,902 2,005	↑	↑	↑	↑
Q	↓	41 3,596 3,153 3,242	62 3,386 3,035 3,238	68 3,338 3,005 3,177	62 3,192 2,858 3,023	81 3,002 2,720 2,880	97 2,875 2,625 2,777	125 2,705 2,493 2,630	158 2,538 2,356 2,479	196 2,387 2,230 2,337	234 2,226 2,089 2,186	↑	↑	↑	↑	↑
R	47 3,720 3,290 3,369	71 3,514 3,173 3,368	78 3,467 3,144 3,309	71 3,325 3,000 3,162	94 3,141 2,868 3,025	115 3,021 2,780 2,926	149 2,858 2,653 2,785	191 2,698 2,524 2,642	239 2,554 2,404 2,508	297 2,404 2,274 2,365	↑	↑	↑	↑	↑	↑

NOTE 1 The sample size code letters in this part of ISO 3951 correspond to those given in ISO 2859-1, ISO 3951-1 and ISO 3951-2.

NOTE 2 Symbols: ↓ There is no suitable plan in this area; use the first sampling plan below the arrow. If the sample size equals or exceeds the lot size, carry out 100 % inspection.

↑ There is no suitable plan in this area; use the first sampling plan above the arrow.

NOTE 3 Numbers in boldface type indicate single sampling plan by attributes of the form n, Ac. If Ac is a fraction, a lot is acceptable if 1/Ac consecutive lots including the present one contain no more than one nonconforming item in total.

Table 12 — Form k double sampling plans for reduced inspection (master table) — "s" method

Sample size code letter	Acceptance quality limit (in percent nonconforming)															
	0,01	0,015	0,025	0,04	0,065	0,10	0,15	0,25	0,40	0,65	1,0	1,5	2,5	4,0	6,5	10,0
	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c
B, C	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	**2, 0**	**2, ⅕**	**2, ⅓**	**2, ½**
D	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	**3, 0**	**3, ⅕**	**3, ⅓**	**3, ½**	**3,1**
E	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	3 1,696 0,908 1,328	4 1,445 0,798 1,266	4 1,342 0,712 1,155	4 1,242 0,627 1,006	3 0,928 0,249 0,568	3 0,411 -,403 0,059
F	↓	↓	↓	↓	↓	↓	↓	↓	↓	4 1,891 1,153 1,556	6 1,683 1,099 1,490	6 1,587 1,020 1,397	6 1,496 0,944 1,271	4 1,199 0,590 0,944	4 0,786 0,199 0,536	4 0,453 -,182 0,206
G	↓	↓	↓	↓	↓	↓	↓	↓	6 2,113 1,446 1,714	8 1,895 1,342 1,719	9 1,825 1,310 1,617	9 1,740 1,238 1,506	6 1,467 0,920 1,239	6 1,109 0,609 0,914	6 0,843 0,361 0,656	5 0,386 -,176 0,242
H	↓	↓	↓	↓	↓	↓	↓	8 2,291 1,666 1,872	10 2,071 1,538 1,909	11 2,001 1,501 1,824	11 1,921 1,432 1,727	8 1,677 1,160 1,476	9 1,367 0,919 1,182	9 1,133 0,711 0,969	8 0,764 0,345 0,639	8 0,617 0,200 0,493
J	↓	↓	↓	↓	↓	↓	10 2,463 1,863 2,067	13 2,258 1,753 2,099	14 2,188 1,709 2,025	15 2,122 1,666 1,925	12 1,907 1,439 1,684	13 1,613 1,200 1,442	13 1,401 1,014 1,262	13 1,094 0,738 0,981	13 0,972 0,626 0,864	13 0,761 0,427 0,658
K	↓	↓	↓	↓	↓	12 2,616 2,035 2,348	16 2,423 1,936 2,271	18 2,362 1,908 2,196	19 2,297 1,861 2,108	15 2,090 1,638 1,892	17 1,820 1,426 1,668	18 1,630 1,269 1,503	20 1,363 1,046 1,253	20 1,255 0,947 1,154	20 1,072 0,779 0,982	20 0,918 0,636 0,833
L	↓	↓	↓	↓	15 2,778 2,224 2,409	19 2,583 2,109 2,446	23 2,536 2,105 2,365	24 2,471 2,056 2,287	20 2,281 1,857 2,081	23 2,026 1,657 1,880	25 1,851 1,515 1,731	28 1,607 1,311 1,509	29 1,512 1,229 1,420	31 1,354 1,093 1,269	31 1,219 0,969 1,143	↑
M	↓	↓	↓	18 2,923 2,389 2,562	23 2,734 2,278 2,598	28 2,689 2,276 2,522	29 2,626 2,226 2,450	25 2,448 2,043 2,254	30 2,209 1,861 2,066	33 2,045 1,728 1,929	39 1,821 1,547 1,725	40 1,732 1,468 1,646	43 1,587 1,344 1,511	45 1,469 1,239 1,399	↑	↑
N	↓	↓	22 3,073 2,563 2,705	28 2,888 2,451 2,750	33 2,840 2,439 2,684	36 2,786 2,405 2,608	31 2,614 2,227 2,427	38 2,388 2,057 2,250	43 2,235 1,935 2,123	51 2,024 1,764 1,936	55 1,945 1,700 1,862	60 1,812 1,587 1,740	64 1,704 1,493 1,638	↑	↑	↑
P	↓	26 3,209 2,718 2,846	33 3,029 2,606 2,893	39 2,983 2,595 2,830	42 2,928 2,558 2,765	37 2,765 2,391 2,586	47 2,552 2,235 2,418	54 2,406 2,121 2,299	66 2,208 1,963 2,124	71 2,134 1,902 2,056	79 2,011 1,798 1,942	86 1,911 1,714 1,849	↑	↑	↑	↑
Q	30 3,341 2,863 2,991	38 3,165 2,752 3,034	46 3,123 2,748 2,972	50 3,071 2,715 2,905	45 2,915 2,557 2,738	57 2,709 2,405 2,581	67 2,572 2,300 2,467	83 2,384 2,151 2,303	90 2,313 2,093 2,240	102 2,198 1,998 2,134	112 2,106 1,919 2,047	↑	↑	↑	↑	↑
R	44 3,299 2,899 3,171	54 3,260 2,899 3,111	59 3,211 2,867 3,047	53 3,059 2,713 2,888	68 2,861 2,568 2,738	82 2,731 2,472 2,630	103 2,553 2,330 2,475	112 2,486 2,276 2,415	129 2,377 2,187 2,316	144 2,291 2,115 2,234	↑	↑	↑	↑	↑	↑

NOTE 1 The sample size code letters in this part of ISO 3951 correspond to those given in ISO 2859-1, ISO 3951-1 and ISO 3951-2.

NOTE 2 Symbols

↓ There is no suitable plan in this area; use the first sampling plan below the arrow. If the sample size equals or exceeds the lot size, carry out 100 % inspection.

↑ There is no suitable plan in this area; use the first sampling plan above the arrow.

NOTE 3 Numbers in boldface type indicate single sampling plan by attributes of the form n, Ac. If Ac is a fraction, a lot is acceptable if 1/Ac consecutive lots including the present one contain no more than one nonconforming item in total.

Table 13 — Form k double sampling plans for normal inspection (master table) — "σ" method

Sample size code letter	Acceptance quality limit (in percent nonconforming)															
	0,01	0,015	0,025	0,04	0,065	0,10	0,15	0,25	0,40	0,65	1,0	1,5	2,5	4,0	6,5	10,0
	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c
B	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	2 1,520 0,672 0,605	2 1,003 0,155 0,746	2 0,872 0,024 0,589
C	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	2 1,717 0,869 1,033	3 1,322 0,519 1,053	3 1,115 0,449 0,900	2 0,588 0,123 0,441
D	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	2 1,889 1,040 1,342	3 1,486 0,824 1,304	4 1,435 0,800 1,202	3 1,045 0,420 0,838	3 0,582 0,136 0,461
E	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	2 2,056 1,208 1,637	4 1,761 1,163 1,553	4 1,650 1,090 1,437	4 1,394 0,777 1,169	5 0,996 0,514 0,856	4 0,705 0,290 0,599
F	↓	↓	↓	↓	↓	↓	↓	↓	↓	3 2,694 1,494 1,800	4 1,928 1,350 1,761	5 1,886 1,320 1,682	4 1,599 1,015 1,410	6 1,288 0,829 1,136	7 1,055 0,642 0,930	6 0,679 0,301 0,602
G	↓	↓	↓	↓	↓	↓	↓	↓	3 2,641 1,677 1,989	5 2,159 1,598 1,985	6 2,100 1,578 1,892	5 1,847 1,323 1,633	7 1,554 1,120 1,405	8 1,340 0,947 1,228	10 1,040 0,691 0,954	9 0,806 0,483 0,731
H	↓	↓	↓	↓	↓	↓	↓	3 2,690 1,833 2,165	6 2,350 1,824 2,168	6 2,258 1,768 2,071	6 2,061 1,548 1,857	8 1,776 1,357 1,638	10 1,589 1,215 1,479	12 1,320 1,002 1,231	12 1,114 0,818 1,042	14 0,882 0,607 0,816
J	↓	↓	↓	↓	↓	↓	4 2,899 2,114 2,366	6 2,497 2,011 2,329	7 2,446 1,982 2,259	7 2,260 1,784 2,053	9 1,989 1,597 1,855	11 1,815 1,465 1,709	15 1,577 1,275 1,492	17 1,398 1,125 1,327	18 1,189 0,941 1,128	21 0,978 0,749 0,920
K	↓	↓	↓	↓	↓	4 2,975 2,262 2,509	7 2,668 2,203 2,496	8 2,614 2,167 2,429	7 2,411 1,964 2,222	10 2,176 1,807 2,043	13 2,019 1,688 1,912	17 1,796 1,515 1,711	21 1,634 1,379 1,563	21 1,443 1,213 1,386	26 1,256 1,048 1,204	32 1,003 0,812 0,956
L	↓	↓	↓	↓	5 3,155 2,490 2,676	7 2,806 2,359 2,654	8 2,755 2,337 2,581	8 2,588 2,162 2,401	12 2,368 2,017 2,234	14 2,210 1,897 2,107	20 2,005 1,738 1,925	24 1,856 1,616 1,788	25 1,683 1,470 1,627	31 1,514 1,321 1,465	39 1,292 1,119 1,248	↑
M	↓	↓	↓	5 3,245 2,629 2,807	8 2,963 2,532 2,808	9 2,910 2,504 2,742	9 2,749 2,338 2,566	13 2,534 2,198 2,404	16 2,387 2,090 2,286	22 2,191 1,940 2,114	27 2,053 1,828 1,988	31 1,895 1,696 1,841	36 1,738 1,559 1,691	47 1,538 1,378 1,497	↑	↑
N	↓	↓	6 3,413 2,816 2,973	9 3,112 2,698 2,955	10 3,058 2,669 2,888	10 2,901 2,511 2,721	14 2,692 2,371 2,568	18 2,557 2,274 2,457	25 2,371 2,132 2,295	31 2,240 2,027 2,177	38 2,095 1,905 2,041	42 1,947 1,778 1,903	56 1,763 1,615 1,724	↑	↑	↑
P	↓	6 3,508 2,949 3,098	10 3,255 2,858 3,098	11 3,201 2,828 3,033	11 3,050 2,675 2,874	15 2,845 2,537 2,726	19 2,715 2,446 2,620	27 2,541 2,312 2,468	34 2,418 2,217 2,356	44 2,282 2,104 2,229	48 2,142 1,984 2,101	65 1,972 1,834 1,936	↑	↑	↑	↑
Q	7 3,646 3,116 3,226	10 3,370 2,987 3,221	12 3,332 2,972 3,166	11 3,173 2,813 3,005	16 2,986 2,690 2,868	21 2,862 2,603 2,768	30 2,695 2,478 2,624	38 2,577 2,383 2,518	48 2,448 2,278 2,398	54 2,317 2,167 2,276	73 2,157 2,026 2,121	↑	↑	↑	↑	↑
R	11 3,504 3,134 3,355	12 3,452 3,105 3,294	12 3,311 2,962 3,148	18 3,131 2,845 3,016	23 3,010 2,761 2,919	32 2,848 2,639 2,779	41 2,737 2,552 2,679	53 2,613 2,451 2,565	60 2,490 2,347 2,450	83 2,339 2,215 2,305	↑	↑	↑	↑	↑	↑

NOTE 1 The sample size code letters in this part of ISO 3951 correspond to those given in ISO 2859-1, ISO 3951-1 and ISO 3951-2.

NOTE 2 ↓ Symbols: There is no suitable plan in this area; use the first sampling plan below the arrow. If the sample size equals or exceeds the lot size, carry out 100 % inspection.

↑ There is no suitable plan in this area; use the first sampling plan above the arrow.

Table 14 — Form k double sampling plans for tightened inspection (master table) — "σ" method

Sample size code letter	Acceptance quality limit (in percent nonconforming)															
	0,01	0,015	0,025	0,04	0,065	0,10	0,15	0,25	0,40	0,65	1,0	1,5	2,5	4,0	6,5	10,0
	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c
B	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	2 1,520 0,672 0,605	2 1,003 0,155 0,746
C	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	2 1,717 0,869 1,033	3 1,322 0,519 1,053	3 1,115 0,449 0,900
D	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	2 1,889 1,040 1,342	3 1,486 0,824 1,304	4 1,435 0,800 1,202	3 1,045 0,420 0,838
E	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	2 2,056 1,208 1,637	4 1,761 1,163 1,553	4 1,650 1,090 1,437	4 1,394 0,777 1,169	5 0,996 0,514 0,856
F	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	3 2,694 1,494 1,800	4 1,928 1,350 1,761	5 1,886 1,320 1,682	4 1,599 1,015 1,410	6 1,288 0,829 1,136	7 1,055 0,642 0,930
G	↓	↓	↓	↓	↓	↓	↓	↓	↓	3 2,641 1,677 1,989	5 2,159 1,598 1,985	6 2,100 1,578 1,892	5 1,847 1,323 1,633	7 1,554 1,120 1,405	8 1,340 0,947 1,228	10 1,040 0,691 0,954
H	↓	↓	↓	↓	↓	↓	↓	↓	3 2,690 1,833 2,165	6 2,350 1,824 2,168	6 2,258 1,768 2,071	6 2,061 1,548 1,857	8 1,776 1,357 1,638	10 1,589 1,215 1,479	12 1,320 1,002 1,231	13 1,031 0,743 0,962
J	↓	↓	↓	↓	↓	↓	↓	4 2,899 2,114 2,366	6 2,497 2,011 2,329	7 2,446 1,982 2,259	7 2,260 1,784 2,053	9 1,989 1,597 1,855	11 1,815 1,465 1,709	15 1,577 1,275 1,492	16 1,320 1,060 1,252	19 1,077 0,842 1,018
K	↓	↓	↓	↓	↓	↓	4 2,975 2,262 2,509	7 2,668 2,203 2,496	8 2,614 2,167 2,429	7 2,411 1,964 2,222	10 2,176 1,807 2,043	13 2,019 1,688 1,912	17 1,796 1,515 1,711	22 1,565 1,319 1,499	24 1,346 1,128 1,290	29 1,103 0,907 1,054
L	↓	↓	↓	↓	↓	5 3,155 2,490 2,676	7 2,806 2,359 2,654	8 2,755 2,337 2,581	8 2,588 2,162 2,401	12 2,368 2,017 2,234	14 2,210 1,897 2,107	20 2,005 1,738 1,925	26 1,795 1,567 1,731	28 1,593 1,392 1,541	36 1,379 1,200 1,333	↑
M	↓	↓	↓	↓	5 3,245 2,629 2,807	8 2,963 2,532 2,808	9 2,910 2,504 2,742	9 2,749 2,338 2,566	13 2,534 2,198 2,404	16 2,387 2,090 2,286	22 2,191 1,940 2,114	30 1,997 1,781 1,934	33 1,811 1,622 1,761	43 1,617 1,450 1,573	↑	↑
N	↓	↓	↓	6 3,413 2,816 2,973	9 3,112 2,698 2,955	10 3,058 2,669 2,888	10 2,901 2,511 2,721	14 2,692 2,371 2,568	18 2,557 2,274 2,457	25 2,371 2,132 2,295	34 2,187 1,983 2,128	38 2,014 1,837 1,966	50 1,835 1,679 1,794	↑	↑	↑
P	↓	↓	6 3,508 2,949 3,098	10 3,255 2,858 3,098	11 3,201 2,828 3,033	11 3,050 2,675 2,874	15 2,845 2,537 2,726	19 2,715 2,446 2,620	27 2,541 2,312 2,468	38 2,368 2,174 2,311	43 2,205 2,038 2,160	58 2,038 1,892 2,000	↑	↑	↑	↑
Q	↓	7 3,646 3,116 3,226	10 3,370 2,987 3,221	12 3,332 2,972 3,166	11 3,173 2,813 3,005	16 2,986 2,690 2,868	21 2,862 2,603 2,768	30 2,695 2,478 2,624	41 2,529 2,344 2,474	49 2,377 2,219 2,332	65 2,218 2,080 2,182	↑	↑	↑	↑	↑
R	7 3,744 3,239 3,346	11 3,504 3,134 3,355	12 3,452 3,105 3,294	12 3,311 2,962 3,148	18 3,131 2,845 3,016	23 3,010 2,761 2,919	32 2,848 2,639 2,779	45 2,691 2,514 2,638	56 2,546 2,395 2,504	74 2,397 2,267 2,362	↑	↑	↑	↑	↑	↑

NOTE 1 The sample size code letters in this part of ISO 3951 correspond to those given in ISO 2859-1, ISO 3951-1 and ISO 3951-2.

NOTE 2 Symbols:

↓ There is no suitable plan in this area; use the first sampling plan below the arrow. If the sample size equals or exceeds the lot size, carry out 100 % inspection.

↑ There is no suitable plan in this area; use the first sampling plan above the arrow.

Table 15 — Form k double sampling plans for reduced inspection (master table) — "σ" method

Sample size code letter	Acceptance quality limit (in percent nonconforming)															
	0,01	0,015	0,025	0,04	0,065	0,10	0,15	0,25	0,40	0,65	1,0	1,5	2,5	4,0	6,5	10,0
	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c	n k_a k_r k_c
B – D	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	2 1,520 0,672 0,605	2 1,136 0,288 0,851	2 1,003 0,155 0,746	2 0,872 0,024 0,589	2 0,500 -,348 0,033
E	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	2 1,717 0,869 1,033	2 1,477 0,513 1,114	3 1,322 0,519 1,053	3 1,115 0,449 0,900	2 0,588 0,123 0,441	3 0,241 -,235 0,047
F	↓	↓	↓	↓	↓	↓	↓	↓	↓	2 1,889 1,040 1,342	3 1,648 0,900 1,404	3 1,486 0,824 1,304	4 1,435 0,800 1,202	3 1,045 0,420 0,838	3 0,582 0,136 0,461	3 0,232 -,249 0,179
G	↓	↓	↓	↓	↓	↓	↓	↓	2 2,056 1,208 1,637	3 1,808 1,134 1,631	4 1,761 1,163 1,553	4 1,650 1,090 1,437	4 1,394 0,777 1,169	5 0,996 0,514 0,856	4 0,705 0,290 0,599	5 0,312 -,141 0,219
H	↓	↓	↓	↓	↓	↓	↓	3 2,694 1,494 1,800	4 2,066 1,397 1,861	4 1,928 1,350 1,761	5 1,886 1,320 1,682	4 1,599 1,015 1,410	6 1,288 0,829 1,136	7 1,055 0,642 0,930	6 0,679 0,301 0,602	7 0,551 0,176 0,466
J	↓	↓	↓	↓	↓	↓	3 2,641 1,677 1,989	4 2,208 1,602 2,043	5 2,159 1,598 1,985	6 2,100 1,578 1,892	5 1,847 1,323 1,633	7 1,554 1,120 1,405	8 1,340 0,947 1,228	10 1,040 0,691 0,954	9 0,913 0,580 0,836	10 0,713 0,396 0,636
K	↓	↓	↓	↓	↓	3 2,690 1,833 2,165	5 2,419 1,831 2,239	6 2,350 1,824 2,168	6 2,258 1,768 2,071	6 2,061 1,548 1,857	8 1,776 1,357 1,638	10 1,589 1,215 1,479	12 1,320 1,002 1,231	13 1,215 0,908 1,134	13 1,031 0,743 0,962	14 0,882 0,607 0,816
L	↓	↓	↓	↓	4 2,899 2,114 2,366	5 2,562 1,999 2,411	6 2,497 2,011 2,329	7 2,446 1,982 2,259	7 2,260 1,784 2,053	9 1,989 1,597 1,855	11 1,815 1,465 1,709	15 1,577 1,275 1,492	16 1,482 1,195 1,404	16 1,320 1,060 1,252	18 1,189 0,941 1,128	↑
M	↓	↓	↓	4 2,975 2,262 2,509	5 2,684 2,156 2,555	7 2,668 2,203 2,496	8 2,614 2,167 2,429	7 2,411 1,964 2,222	10 2,176 1,807 2,043	13 2,019 1,688 1,912	17 1,796 1,515 1,711	19 1,709 1,440 1,633	22 1,565 1,319 1,499	21 1,443 1,213 1,386	↑	↑
N	↓	↓	5 3,155 2,490 2,676	6 2,866 2,362 2,721	7 2,806 2,359 2,654	8 2,755 2,337 2,581	8 2,588 2,162 2,401	12 2,368 2,017 2,234	14 2,210 1,897 2,107	20 2,005 1,738 1,925	22 1,926 1,676 1,851	26 1,795 1,567 1,731	25 1,683 1,470 1,627	↑	↑	↑
P	↓	5 3,245 2,629 2,807	7 3,028 2,542 2,876	8 2,963 2,532 2,808	9 2,910 2,504 2,742	9 2,749 2,338 2,566	13 2,534 2,198 2,404	16 2,387 2,090 2,286	22 2,191 1,940 2,114	25 2,119 1,882 2,047	30 1,997 1,781 1,934	31 1,895 1,696 1,841	↑	↑	↑	↑
Q	6 3,413 2,816 2,973	7 3,149 2,680 3,012	9 3,112 2,698 2,955	10 3,058 2,669 2,888	10 2,901 2,511 2,721	14 2,692 2,371 2,568	18 2,557 2,274 2,457	25 2,371 2,132 2,295	28 2,300 2,076 2,233	34 2,187 1,983 2,128	38 2,095 1,905 2,041	↑	↑	↑	↑	↑
R	8 3,300 2,847 3,158	10 3,255 2,858 3,098	11 3,201 2,828 3,033	11 3,050 2,675 2,874	15 2,845 2,537 2,726	19 2,715 2,446 2,620	27 2,541 2,312 2,468	31 2,475 2,261 2,409	38 2,368 2,174 2,311	44 2,282 2,104 2,229	↑	↑	↑	↑	↑	↑

NOTE 1 The sample size code letters in this part of ISO 3951 correspond to those given in ISO 2859-1, ISO 3951-1 and ISO 3951-2.

NOTE 2 Symbols:

↓ There is no suitable plan in this area; use the first sampling plan below the arrow. If the sample size equals or exceeds the lot size, carry out 100 % inspection.

↑ There is no suitable plan in this area; use the first sampling plan above the arrow.

Table 16 — Values of $f_{s,1}$ and $f_{s,\mathrm{c}}$ for maximum sample standard deviation (MSSD) for combined control of double specification limits — Normal inspection, "s" method

Sample size code letter	Acceptance quality limit (in percent nonconforming)															
	0,01	0,015	0,025	0,04	0,065	0,10	0,15	0,25	0,40	0,65	1,0	1,5	2,5	4,0	6,5	10,0
	$f_{s,1}$ $f_{s,\mathrm{c}}$	$f_{s,1}$ $f_{s,\mathrm{c}}$	$f_{s,1}$ $f_{s,\mathrm{c}}$	$f_{s,1}$ $f_{s,\mathrm{c}}$	$f_{s,1}$ $f_{s,\mathrm{c}}$	$f_{s,1}$ $f_{s,\mathrm{c}}$	$f_{s,1}$ $f_{s,\mathrm{c}}$	$f_{s,1}$ $f_{s,\mathrm{c}}$	$f_{s,1}$ $f_{s,\mathrm{c}}$	$f_{s,1}$ $f_{s,\mathrm{c}}$	$f_{s,1}$ $f_{s,\mathrm{c}}$	$f_{s,1}$ $f_{s,\mathrm{c}}$	$f_{s,1}$ $f_{s,\mathrm{c}}$	$f_{s,1}$ $f_{s,\mathrm{c}}$	$f_{s,1}$ $f_{s,\mathrm{c}}$	$f_{s,1}$ $f_{s,\mathrm{c}}$
C													0,4848 0,3299	0,4521 0,3429	0,4701 0,3691	0,7124 0,4721
D												0,3769 0,2866	0,3729 0,2977	0,3873 0,3162	0,4785 0,3812	0,5886 0,4812
E											0,3073 0,2589	0,3141 0,2651	0,3251 0,2787	0,3921 0,3212	0,4650 0,3814	0,5425 0,4450
F										0,2709 0,2391	0,2843 0,2413	0,2934 0,2513	0,3403 0,2836	0,3837 0,3265	0,4327 0,3666	0,5503 0,4487
G									0,2455 0,2198	0,2567 0,2214	0,2607 0,2300	0,2912 0,2555	0,3261 0,2848	0,3598 0,3112	0,4226 0,3623	0,4860 0,4145
H								0,2270 0,2044	0,2343 0,2066	0,2384 0,2133	0,2639 0,2331	0,2895 0,2557	0,3121 0,2754	0,3504 0,3111	0,3903 0,3443	0,4491 0,3942
J							0,2093 0,1921	0,2155 0,1937	0,2193 0,1990	0,2384 0,2153	0,2586 0,2328	0,2753 0,2477	0,3032 0,2735	0,3281 0,2964	0,3641 0,3288	0,4106 0,3706
K						0,1960 0,1818	0,2015 0,1831	0,2050 0,1876	0,2202 0,2013	0,2360 0,2156	0,2492 0,2275	0,2696 0,2475	0,2881 0,2646	0,3130 0,2876	0,3431 0,3160	0,3953 0,3632
L					0,1837 0,1730	0,1897 0,1734	0,1916 0,1776	0,2047 0,1890	0,2174 0,2009	0,2278 0,2104	0,2441 0,2263	0,2577 0,2395	0,2753 0,2567	0,2967 0,2769	0,3303 0,3089	
M				0,1740 0,1652	0,1795 0,1654	0,1815 0,1688	0,1925 0,1788	0,2028 0,1890	0,2113 0,1969	0,2244 0,2099	0,2351 0,2206	0,2486 0,2341	0,2644 0,2496	0,2887 0,2729		
N			0,1658 0,1579	0,1705 0,1583	0,1721 0,1614	0,1814 0,1700	0,1905 0,1787	0,1974 0,1855	0,2083 0,1963	0,2169 0,2050	0,2277 0,2159	0,2400 0,2281	0,2581 0,2461			
P		0,1582 0,1517	0,1625 0,1519	0,1639 0,1546	0,1721 0,1622	0,1800 0,1697	0,1856 0,1755	0,1948 0,1847	0,2018 0,1921	0,2106 0,2011	0,2205 0,2109	0,2346 0,2251				
Q	0,1514 0,1466	0,1558 0,1464	0,1571 0,1489	0,1643 0,1557	0,1711 0,1623	0,1762 0,1674	0,1839 0,1753	0,1901 0,1816	0,1974 0,1893	0,2055 0,1975	0,2170 0,2093					
R	0,1496 0,1412	0,1507 0,1435	0,1573 0,1495	0,1633 0,1553	0,1676 0,1599	0,1743 0,1668	0,1794 0,1722	0,1857 0,1787	0,1924 0,1858	0,2019 0,1955						

NOTE 1 The MSSD $s_{1,\mathrm{max}}$ under normal inspection for the initial sample is obtained by multiplying the standardized factor $f_{s,1}$ from the above table by the difference between the upper specification limit U and the lower specification limit L, i.e. $s_{1,\mathrm{max}} = (U - L)f_{s,1}$. Similarly, the MSSD $s_{\mathrm{c,max}}$ under normal inspection for the combined sample is obtained as $s_{\mathrm{c,max}} = (U - L)f_{s,\mathrm{c}}$.

NOTE 2 These MSSDs indicate the greatest allowable magnitude of the corresponding sample standard deviations s_1 and s_{c} under normal inspection for double specification limits with a combined AQL requirement when the process variability is unknown. If a sample standard deviation is less than its corresponding MSSD, there is a possibility but not a certainty that the lot will be acceptable.

Table 17 — Values of $f_{s,1}$ and $f_{s,c}$ for maximum sample standard deviation (MSSD) for combined control of double specification limits — Tightened inspection, "s" method

Sample size code letter	Acceptance quality limit (in percent nonconforming)															
	0,01	0,015	0,025	0,04	0,065	0,10	0,15	0,25	0,40	0,65	1,0	1,5	2,5	4,0	6,5	10,0
	$f_{s,1}$ $f_{s,c}$	$f_{s,1}$ $f_{s,c}$	$f_{s,1}$ $f_{s,c}$	$f_{s,1}$ $f_{s,c}$	$f_{s,1}$ $f_{s,c}$	$f_{s,1}$ $f_{s,c}$	$f_{s,1}$ $f_{s,c}$	$f_{s,1}$ $f_{s,c}$	$f_{s,1}$ $f_{s,c}$	$f_{s,1}$ $f_{s,c}$	$f_{s,1}$ $f_{s,c}$	$f_{s,1}$ $f_{s,c}$	$f_{s,1}$ $f_{s,c}$	$f_{s,1}$ $f_{s,c}$	$f_{s,1}$ $f_{s,c}$	$f_{s,1}$ $f_{s,c}$
C														0,4848 0,3299	0,4521 0,3429	0,4701 0,3691
D													0,3769 0,2866	0,3729 0,2977	0,3873 0,3162	0,4785 0,3812
E												0,3073 0,2589	0,3141 0,2651	0,3251 0,2787	0,3921 0,3212	0,4650 0,3814
F											0,2709 0,2391	0,2843 0,2413	0,2934 0,2513	0,3403 0,2836	0,3837 0,3265	0,4327 0,3666
G										0,2455 0,2198	0,2567 0,2214	0,2607 0,2300	0,2912 0,2555	0,3261 0,2848	0,3598 0,3112	0,4226 0,3623
H									0,2270 0,2044	0,2343 0,2066	0,2384 0,2133	0,2639 0,2331	0,2895 0,2557	0,3121 0,2754	0,3504 0,3111	0,4098 0,3607
J								0,2093 0,1921	0,2155 0,1937	0,2193 0,1990	0,2384 0,2153	0,2586 0,2328	0,2753 0,2477	0,3032 0,2735	0,3396 0,3076	0,3867 0,3497
K							0,1960 0,1818	0,2015 0,1831	0,2050 0,1876	0,2202 0,2013	0,2360 0,2156	0,2492 0,2275	0,2696 0,2475	0,2968 0,2726	0,3281 0,3020	0,3728 0,3431
L						0,1837 0,1730	0,1897 0,1734	0,1916 0,1776	0,2047 0,1890	0,2174 0,2009	0,2278 0,2104	0,2441 0,2263	0,2637 0,2455	0,2862 0,2671	0,3161 0,2956	
M					0,1740 0,1652	0,1795 0,1654	0,1815 0,1688	0,1925 0,1788	0,2028 0,1890	0,2113 0,1969	0,2244 0,2099	0,2399 0,2253	0,2569 0,2421	0,2786 0,2634		
N				0,1658 0,1579	0,1705 0,1583	0,1721 0,1614	0,1814 0,1700	0,1905 0,1787	0,1974 0,1855	0,2083 0,1963	0,2207 0,2089	0,2340 0,2223	0,2507 0,2388			
P			0,1582 0,1517	0,1625 0,1519	0,1639 0,1546	0,1721 0,1622	0,1800 0,1697	0,1856 0,1755	0,1948 0,1847	0,2050 0,1952	0,2158 0,2062	0,2289 0,2194				
Q		0,1514 0,1466	0,1558 0,1464	0,1571 0,1489	0,1643 0,1557	0,1711 0,1623	0,1762 0,1674	0,1839 0,1753	0,1927 0,1843	0,2015 0,1936	0,2124 0,2045					
R	0,1455 0,1415	0,1496 0,1412	0,1507 0,1435	0,1573 0,1495	0,1633 0,1553	0,1676 0,1599	0,1743 0,1668	0,1817 0,1745	0,1893 0,1824	0,1981 0,1916						

NOTE 1 The MSSD $s_{1,\max}$ under tightened inspection for the initial sample is obtained by multiplying the standardized factor $f_{s,1}$ from the above table by the difference between the upper specification limit U and the lower specification limit L, i.e. $s_{1,\max} = (U - L) f_{s,1}$. Similarly, the MSSD $s_{\mathrm{c},\max}$ under tightened inspection for the combined sample is obtained as $s_{\mathrm{c},\max} = (U - L) f_{s,\mathrm{c}}$.

NOTE 2 These MSSDs indicate the greatest allowable magnitude of the corresponding sample standard deviations s_1 and s_c under tightened inspection for double specification limits with a combined AQL requirement when the process variability is unknown. If a sample standard deviation is less than its corresponding MSSD, there is a possibility but not a certainty that the lot will be acceptable.

Table 18 — Values of $f_{s,1}$ and $f_{s,\text{c}}$ for maximum sample standard deviation (MSSD) for combined control of double specification limits — Reduced inspection, "s" method

Sample size code letter	Acceptance quality limit (in percent nonconforming)															
	0,01	0,015	0,025	0,04	0,065	0,10	0,15	0,25	0,40	0,65	1,0	1,5	2,5	4,0	6,5	10,0
	$f_{s,1}$ $f_{s,\text{c}}$	$f_{s,1}$ $f_{s,\text{c}}$	$f_{s,1}$ $f_{s,\text{c}}$	$f_{s,1}$ $f_{s,\text{c}}$	$f_{s,1}$ $f_{s,\text{c}}$	$f_{s,1}$ $f_{s,\text{c}}$	$f_{s,1}$ $f_{s,\text{c}}$	$f_{s,1}$ $f_{s,\text{c}}$	$f_{s,1}$ $f_{s,\text{c}}$	$f_{s,1}$ $f_{s,\text{c}}$	$f_{s,1}$ $f_{s,\text{c}}$	$f_{s,1}$ $f_{s,\text{c}}$	$f_{s,1}$ $f_{s,\text{c}}$	$f_{s,1}$ $f_{s,\text{c}}$	$f_{s,1}$ $f_{s,\text{c}}$	$f_{s,1}$ $f_{s,\text{c}}$
E											0,4848 0,3299	0,4352 0,3254	0,4521 0,3429	0,4701 0,3691	0,7124 0,4721	1,3303 0,6494
F										0,3769 0,2866	0,3589 0,2853	0,3729 0,2977	0,3873 0,3162	0,4785 0,3812	0,5886 0,4812	10,3685 0,5805
G									0,3073 0,2589	0,3119 0,2547	0,3141 0,2651	0,3251 0,2787	0,3921 0,3212	0,4650 0,3814	0,5425 0,4450	0,7965 0,5913
H								0,2709 0,2391	0,2811 0,2337	0,2843 0,2413	0,2934 0,2513	0,3403 0,2836	0,3837 0,3265	0,4327 0,3666	0,5503 0,4487	0,6120 0,4951
J							0,2455 0,2198	0,2528 0,2155	0,2567 0,2214	0,2607 0,2300	0,2912 0,2555	0,3261 0,2848	0,3598 0,3112	0,4226 0,3623	0,4538 0,3880	0,5197 0,4418
K						0,2270 0,2044	0,2327 0,2014	0,2343 0,2066	0,2384 0,2133	0,2639 0,2331	0,2895 0,2557	0,3121 0,2754	0,3504 0,3111	0,3706 0,3278	0,4098 0,3607	0,4491 0,3942
L					0,2093 0,1921	0,2164 0,1888	0,2155 0,1937	0,2193 0,1990	0,2384 0,2153	0,2586 0,2328	0,2753 0,2477	0,3032 0,2735	0,3160 0,2853	0,3396 0,3076	0,3641 0,3288	
M				0,1960 0,1818	0,2023 0,1790	0,2015 0,1831	0,2050 0,1876	0,2202 0,2013	0,2360 0,2156	0,2492 0,2275	0,2696 0,2475	0,2796 0,2563	0,2968 0,2726	0,3130 0,2876		
N			0,1837 0,1730	0,1895 0,1701	0,1897 0,1734	0,1916 0,1776	0,2047 0,1890	0,2174 0,2009	0,2278 0,2104	0,2441 0,2263	0,2508 0,2331	0,2637 0,2455	0,2753 0,2567			
P		0,1740 0,1652	0,1794 0,1625	0,1795 0,1654	0,1815 0,1688	0,1925 0,1788	0,2028 0,1890	0,2113 0,1969	0,2244 0,2099	0,2299 0,2155	0,2399 0,2253	0,2486 0,2341				
Q	0,1658 0,1579	0,1708 0,1556	0,1705 0,1583	0,1721 0,1614	0,1814 0,1700	0,1905 0,1787	0,1974 0,1855	0,2083 0,1963	0,2128 0,2008	0,2207 0,2089	0,2277 0,2159					
R	0,1629 0,1495	0,1625 0,1519	0,1639 0,1546	0,1721 0,1622	0,1800 0,1697	0,1856 0,1755	0,1948 0,1847	0,1985 0,1886	0,2050 0,1952	0,2106 0,2011						

NOTE 1 The MSSD $s_{1,\text{max}}$ under reduced inspection for the initial sample is obtained by multiplying the standardized factor $f_{s,1}$ from the above table by the difference between the upper specification limit U and the lower specification limit L, i.e. $s_{1,\text{max}} = (U - L) f_{s,1}$. Similarly, the MSSD $s_{\text{c,max}}$ under reduced inspection for the combined sample is obtained as $s_{\text{c,max}} = (U - L) f_{s,\text{c}}$.

NOTE 2 These MSSDs indicate the greatest allowable magnitude of the corresponding sample standard deviations s_1 and s_c under reduced inspection for double specification limits with a combined AQL requirement when the process variability is unknown. If a sample standard deviation is less than its corresponding MSSD, there is a possibility but not a certainty that the lot will be acceptable.

Table 19 — Values of f_σ for maximum process standard deviation (MPSD) for combined control of double specification limits — "σ" method

	Acceptance quality limit (in percent nonconforming)															
	0,01	0,015	0,025	0,040	0,065	0,10	0,15	0,25	0,40	0,65	1,0	1,5	2,5	4,0	6,5	10,0
f_σ	0,125	0,129	0,132	0,137	0,141	0,147	0,152	0,157	0,165	0,174	0,184	0,194	0,206	0,223	0,243	0,271

NOTE 1 The MPSD is obtained by multiplying the standardized MPSD f_σ by the difference between the upper specification limit U and the lower specification limit L, i.e. $\sigma_{\max} = (U - L) f_\sigma$.

NOTE 2 The MPSD indicates the greatest allowable magnitude of the process standard deviation when using plans for combined control of double specification limits when the process variability is known. If the process standard deviation is less than the appropriate MPSD from this table, there is a possibility but not a certainty that the lot will be accepted.

Table 20 — Values of f_σ for maximum process standard deviation (MPSD) for separate control of double specification limits — "σ" method

AQL % (lower limit)	Acceptance quality limit in percent (upper limit)															
	0,010	0,015	0,025	0,040	0,065	0,10	0,15	0,25	0,40	0,65	1,0	1,5	2,5	4,0	6,5	10,0
0,010	0,131	0,133	0,134	0,137	0,139	0,142	0,145	0,147	0,151	0,154	0,158	0,163	0,167	0,173	0,179	0,187
0,015	0,133	0,134	0,136	0,139	0,141	0,144	0,147	0,150	0,153	0,157	0,161	0,165	0,170	0,176	0,183	0,191
0,025	0,134	0,136	0,138	0,141	0,144	0,146	0,149	0,152	0,156	0,160	0,164	0,168	0,173	0,179	0,186	0,195
0,040	0,137	0,139	0,141	0,144	0,146	0,149	0,152	0,155	0,159	0,163	0,168	0,172	0,177	0,184	0,191	0,200
0,065	0,139	0,141	0,144	0,146	0,149	0,152	0,155	0,158	0,162	0,167	0,171	0,176	0,181	0,188	0,196	0,205
0,10	0,142	0,144	0,146	0,149	0,152	0,155	0,159	0,162	0,166	0,170	0,175	0,180	0,186	0,193	0,201	0,211
0,15	0,145	0,147	0,149	0,152	0,155	0,159	0,162	0,165	0,170	0,174	0,179	0,185	0,190	0,198	0,207	0,217
0,25	0,147	0,150	0,152	0,155	0,158	0,162	0,165	0,168	0,173	0,178	0,183	0,189	0,195	0,203	0,212	0,223
0,40	0,151	0,153	0,156	0,159	0,162	0,166	0,170	0,173	0,178	0,183	0,189	0,195	0,201	0,210	0,219	0,231
0,65	0,154	0,157	0,160	0,163	0,167	0,170	0,174	0,178	0,183	0,189	0,195	0,201	0,207	0,217	0,227	0,240
1,0	0,158	0,161	0,164	0,168	0,171	0,175	0,179	0,183	0,189	0,195	0,201	0,208	0,215	0,225	0,236	0,250
1,5	0,163	0,165	0,168	0,172	0,176	0,180	0,185	0,189	0,195	0,201	0,208	0,215	0,222	0,233	0,245	0,260
2,5	0,167	0,170	0,173	0,177	0,181	0,186	0,190	0,195	0,201	0,207	0,215	0,222	0,230	0,242	0,255	0,271
4,0	0,173	0,176	0,179	0,184	0,188	0,193	0,198	0,203	0,210	0,217	0,225	0,233	0,242	0,255	0,269	0,288
6,5	0,179	0,183	0,186	0,191	0,196	0,201	0,207	0,212	0,219	0,227	0,236	0,245	0,255	0,269	0,286	0,306
10,0	0,187	0,191	0,195	0,200	0,205	0,211	0,217	0,223	0,231	0,240	0,250	0,260	0,271	0,288	0,306	0,330

NOTE 1 The MPSD is obtained by multiplying the standardized MPSD f_σ by the difference between the upper specification limit U and the lower specification limit L, i.e. $\sigma_{max} = (U - L) f_\sigma$.

NOTE 2 These values of the MPSD indicate the greatest allowable magnitude of the process standard deviation when using plans for separate control of double specification limits when the process standard deviation is known. If the process standard deviation is less than the appropriate MPSD from this table, there is a possibility but not a certainty that the lot will be accepted.

Table 21 — Values of f_σ for maximum process standard deviation (MPSD) for complex control of double specification limits — "σ" method

AQL % (single limit)	Acceptance quality limit in percent (both limits combined)														
	0,015	0,025	0,040	0,065	0,10	0,15	0,25	0,40	0,65	1,0	1,5	2,5	4,0	6,5	10,0
0,010	0,129	0,132	0,135	0,138	0,141	0,144	0,147	0,151	0,154	0,158	0,162	0,167	0,173	0,179	0,187
0,015		0,132	0,136	0,140	0,143	0,146	0,149	0,153	0,157	0,161	0,165	0,170	0,176	0,183	0,191
0,025			0,137	0,141	0,145	0,148	0,151	0,155	0,159	0,164	0,168	0,173	0,179	0,186	0,195
0,040				0,141	0,146	0,150	0,154	0,158	0,162	0,167	0,172	0,177	0,184	0,191	0,200
0,065					0,147	0,152	0,156	0,161	0,166	0,171	0,176	0,181	0,188	0,196	0,205
0,10						0,152	0,157	0,163	0,169	0,174	0,180	0,185	0,193	0,201	0,211
0,15							0,157	0,165	0,171	0,178	0,183	0,189	0,197	0,206	0,217
0,25								0,165	0,173	0,180	0,187	0,193	0,202	0,211	0,223
0,40									0,174	0,183	0,191	0,198	0,208	0,218	0,230
0,65										0,184	0,194	0,202	0,213	0,225	0,238
1,0											0,194	0,205	0,219	0,232	0,247
1,5												0,206	0,222	0,238	0,255
2,5													0,223	0,242	0,262
4,0														0,243	0,269
6,5															0,271

NOTE 1 The MPSD is obtained by multiplying the standardized MPSD f_σ by the difference between the upper specification limit U and the lower specification limit L, i.e. $\sigma_{max} = (U - L) f_\sigma$.

NOTE 2 These values of the MPSD indicate the greatest allowable magnitude of the process standard deviation when using plans for complex control of double specification limits when the process standard deviation is known. If the process standard deviation is less than the appropriate MPSD from this table, there is a possibility, but not a certainty, that the lot will be accepted.

Table 22 — Estimated process average, $\hat{p}$, as a function of the quality statistic Q for sample size 3 — "s" method

$\sqrt{3}Q/2$	0,000	0,001	0,002	0,003	0,004	0,005	0,006	0,007	0,008	0,009
0,00	0,500 0	0,499 7	0,499 4	0,499 0	0,498 7	0,498 4	0,498 1	0,497 8	0,497 5	0,497 1
0,01	0,496 8	0,496 5	0,496 2	0,495 9	0,495 5	0,495 2	0,494 9	0,494 6	0,494 3	0,494 0
0,02	0,493 6	0,493 3	0,493 0	0,492 7	0,492 4	0,492 0	0,491 7	0,491 4	0,491 1	0,490 8
0,03	0,490 4	0,490 1	0,489 8	0,489 5	0,489 2	0,488 9	0,488 5	0,488 2	0,487 9	0,487 6
0,04	0,487 3	0,486 9	0,486 6	0,486 3	0,486 0	0,485 7	0,485 4	0,485 0	0,484 7	0,484 4
0,05	0,484 1	0,483 8	0,483 4	0,483 1	0,482 8	0,482 5	0,482 2	0,481 8	0,481 5	0,481 2
0,06	0,480 9	0,480 6	0,480 3	0,479 9	0,479 6	0,479 3	0,479 0	0,478 7	0,478 3	0,478 0
0,07	0,477 7	0,477 4	0,477 1	0,476 7	0,476 4	0,476 1	0,475 8	0,475 5	0,475 1	0,474 8
0,08	0,474 5	0,474 2	0,473 9	0,473 5	0,473 2	0,472 9	0,472 6	0,472 3	0,472 0	0,471 6
0,09	0,471 3	0,471 0	0,470 7	0,470 4	0,470 0	0,469 7	0,469 4	0,469 1	0,468 8	0,468 4
0,10	0,468 1	0,467 8	0,467 5	0,467 2	0,466 8	0,466 5	0,466 2	0,465 9	0,465 6	0,465 2
0,11	0,464 9	0,464 6	0,464 3	0,464 0	0,463 6	0,463 3	0,463 0	0,462 7	0,462 4	0,462 0
0,12	0,461 7	0,461 4	0,461 1	0,460 7	0,460 4	0,460 1	0,459 8	0,459 5	0,459 1	0,458 8
0,13	0,458 5	0,458 2	0,457 9	0,457 5	0,457 2	0,456 9	0,456 6	0,456 3	0,455 9	0,455 6
0,14	0,455 3	0,455 0	0,454 6	0,454 3	0,454 0	0,453 7	0,453 4	0,453 0	0,452 7	0,452 4
0,15	0,452 1	0,451 8	0,451 4	0,451 1	0,450 8	0,450 5	0,450 1	0,449 8	0,449 5	0,449 2
0,16	0,448 9	0,448 5	0,448 2	0,447 9	0,447 6	0,447 2	0,446 9	0,446 6	0,446 3	0,445 9
0,17	0,445 6	0,445 3	0,445 0	0,444 7	0,444 3	0,444 0	0,443 7	0,443 4	0,443 0	0,442 7
0,18	0,442 4	0,442 1	0,441 7	0,441 4	0,441 1	0,440 8	0,440 4	0,440 1	0,439 8	0,439 5
0,19	0,439 2	0,438 8	0,438 5	0,438 2	0,437 9	0,437 5	0,437 2	0,436 9	0,436 6	0,436 2
0,20	0,435 9	0,435 6	0,435 3	0,434 9	0,434 6	0,434 3	0,434 0	0,433 6	0,433 3	0,433 0
0,21	0,432 7	0,432 3	0,432 0	0,431 7	0,431 4	0,431 0	0,430 7	0,430 4	0,430 0	0,429 7
0,22	0,429 4	0,429 1	0,428 7	0,428 4	0,428 1	0,427 8	0,427 4	0,427 1	0,426 8	0,426 5
0,23	0,426 1	0,425 8	0,425 5	0,425 1	0,424 8	0,424 5	0,424 2	0,423 8	0,423 5	0,423 2
0,24	0,422 9	0,422 5	0,422 2	0,421 9	0,421 5	0,421 2	0,420 9	0,420 6	0,420 2	0,419 9
0,25	0,419 6	0,419 2	0,418 9	0,418 6	0,418 3	0,417 9	0,417 6	0,417 3	0,416 9	0,416 6
0,26	0,416 3	0,415 9	0,415 6	0,415 3	0,415 0	0,414 6	0,414 3	0,414 0	0,413 6	0,413 3
0,27	0,413 0	0,412 6	0,412 3	0,412 0	0,411 7	0,411 3	0,411 0	0,410 7	0,410 3	0,410 0
0,28	0,409 7	0,409 3	0,409 0	0,408 7	0,408 3	0,408 0	0,407 7	0,407 3	0,407 0	0,406 7
0,29	0,406 3	0,406 0	0,405 7	0,405 3	0,405 0	0,404 7	0,404 3	0,404 0	0,403 7	0,403 3
0,30	0,403 0	0,402 7	0,402 3	0,402 0	0,401 7	0,401 3	0,401 0	0,400 7	0,400 3	0,400 0
0,31	0,399 7	0,399 3	0,399 0	0,398 7	0,398 3	0,398 0	0,397 7	0,397 3	0,397 0	0,396 7
0,32	0,396 3	0,396 0	0,395 6	0,395 3	0,395 0	0,394 6	0,394 3	0,394 0	0,393 6	0,393 3
0,33	0,393 0	0,392 6	0,392 3	0,391 9	0,391 6	0,391 3	0,390 9	0,390 6	0,390 2	0,389 9
0,34	0,389 6	0,389 2	0,388 9	0,388 6	0,388 2	0,387 9	0,387 5	0,387 2	0,386 9	0,386 5
0,35	0,386 2	0,385 8	0,385 5	0,385 2	0,384 8	0,384 5	0,384 1	0,383 8	0,383 5	0,383 1
0,36	0,382 8	0,382 4	0,382 1	0,381 8	0,381 4	0,381 1	0,380 7	0,380 4	0,380 0	0,379 7
0,37	0,379 4	0,379 0	0,378 7	0,378 3	0,378 0	0,377 6	0,377 3	0,377 0	0,376 6	0,376 3
0,38	0,375 9	0,375 6	0,375 2	0,374 9	0,374 5	0,374 2	0,373 9	0,373 5	0,373 2	0,372 8
0,39	0,372 5	0,372 1	0,371 8	0,371 4	0,371 1	0,370 7	0,370 4	0,370 1	0,369 7	0,369 4
0,40	0,369 0	0,368 7	0,368 3	0,368 0	0,367 6	0,367 3	0,366 9	0,366 6	0,366 2	0,365 9
0,41	0,365 5	0,365 2	0,364 8	0,364 5	0,364 1	0,363 8	0,363 4	0,363 1	0,362 7	0,362 4
0,42	0,362 0	0,361 7	0,361 3	0,361 0	0,360 6	0,360 3	0,359 9	0,359 6	0,359 2	0,358 9
0,43	0,358 5	0,358 2	0,357 8	0,357 5	0,357 1	0,356 7	0,356 4	0,356 0	0,355 7	0,355 3
0,44	0,355 0	0,354 6	0,354 3	0,353 9	0,353 6	0,353 2	0,352 8	0,352 5	0,352 1	0,351 8
0,45	0,351 4	0,351 1	0,350 7	0,350 4	0,350 0	0,349 6	0,349 3	0,348 9	0,348 6	0,348 2
0,46	0,347 8	0,347 5	0,347 1	0,346 8	0,346 4	0,346 1	0,345 7	0,345 3	0,345 0	0,344 6
0,47	0,344 3	0,343 9	0,343 5	0,343 2	0,342 8	0,342 4	0,342 1	0,341 7	0,341 4	0,341 0
0,48	0,340 6	0,340 3	0,339 9	0,339 5	0,339 2	0,338 8	0,338 5	0,338 1	0,337 7	0,337 4
0,49	0,337 0	0,336 6	0,336 3	0,335 9	0,335 5	0,335 2	0,334 8	0,334 4	0,334 1	0,333 7
0,50	0,333 3	0,333 0	0,332 6	0,332 2	0,331 9	0,331 5	0,331 1	0,330 8	0,330 4	0,330 0

NOTE For negative values of Q, enter the table with the absolute value of $\sqrt{3}Q/2$ and subtract the result from 1,0.

Table 22 *(continued)*

$\sqrt{3}Q/2$	0,000	0,001	0,002	0,003	0,004	0,005	0,006	0,007	0,008	0,009
0,51	0,329 6	0,329 3	0,328 9	0,328 5	0,328 2	0,327 8	0,327 4	0,327 0	0,326 7	0,326 3
0,52	0,325 9	0,3256	0,325 2	0,324 8	0,324 4	0,324 1	0,323 7	0,323 3	0,322 9	0,322 6
0,51	0,329 6	0,329 3	0,328 9	0,328 5	0,328 2	0,327 8	0,327 4	0,327 0	0,326 7	0,326 3
0,52	0,325 9	0,3256	0,325 2	0,324 8	0,324 4	0,324 1	0,323 7	0,323 3	0,322 9	0,322 6
0,53	0,322 2	0,321 8	0,321 4	0,321 1	0,320 7	0,320 3	0,319 9	0,319 6	0,319 2	0,318 8
0,54	0,318 4	0,318 0	0,317 7	0,317 3	0,316 9	0,316 5	0,316 1	0,315 8	0,315 4	0,315 0
0,55	0,314 6	0,314 2	0,313 9	0,313 5	0,313 1	0,312 7	0,312 3	0,312 0	0,311 6	0,311 2
0,56	0,310 8	0,310 4	0,310 0	0,309 6	0,309 3	0,308 9	0,308 5	0,308 1	0,307 7	0,307 3
0,57	0,306 9	0,306 6	0,306 2	0,305 8	0,305 4	0,305 0	0,304 6	0,304 2	0,303 8	0,303 4
0,58	0,303 1	0,302 7	0,302 3	0,301 9	0,301 5	0,301 1	0,300 7	0,300 3	0,299 9	0,299 5
0,59	0,299 1	0,298 7	0,298 3	0,297 9	0,297 5	0,297 2	0,296 8	0,296 4	0,296 0	0,295 6
0,60	0,295 2	0,294 8	0,294 4	0,294 0	0,293 6	0,293 2	0,292 8	0,292 4	0,292 0	0,291 6
0,61	0,291 2	0,290 8	0,290 4	0,290 0	0,289 6	0,289 2	0,288 8	0,288 3	0,287 9	0,287 5
0,62	0,287 1	0,286 7	0,286 3	0,285 9	0,285 5	0,285 1	0,284 7	0,284 3	0,283 9	0,283 5
0,63	0,283 1	0,282 6	0,282 2	0,281 8	0,281 4	0,281 0	0,280 6	0,280 2	0,279 8	0,279 3
0,64	0,278 9	0,278 5	0,278 1	0,277 7	0,277 3	0,276 9	0,276 4	0,276 0	0,275 6	0,275 2
0,65	0,274 8	0,274 3	0,273 9	0,273 5	0,273 1	0,272 7	0,272 2	0,271 8	0,271 4	0,271 0
0,66	0,270 6	0,270 1	0,269 7	0,269 3	0,268 9	0,268 4	0,268 0	0,267 6	0,267 2	0,266 7
0,67	0,266 3	0,265 9	0,265 4	0,265 0	0,264 6	0,264 1	0,263 7	0,263 3	0,262 8	0,262 4
0,68	0,262 0	0,261 5	0,261 1	0,260 7	0,260 2	0,259 8	0,259 4	0,258 9	0,258 5	0,258 0
0,69	0,257 6	0,257 2	0,256 7	0,256 3	0,255 8	0,255 4	0,255 0	0,254 5	0,254 1	0,253 6
0,70	0,253 2	0,252 7	0,252 3	0,251 8	0,251 4	0,250 9	0,250 5	0,250 0	0,249 6	0,249 1
0,71	0,248 7	0,248 2	0,247 8	0,247 3	0,246 9	0,246 4	0,246 0	0,245 5	0,245 1	0,244 6
0,72	0,244 1	0,243 7	0,243 2	0,242 8	0,242 3	0,241 8	0,241 4	0,240 9	0,240 5	0,240 0
0,73	0,239 5	0,239 1	0,238 6	0,238 1	0,237 7	0,237 2	0,236 7	0,236 2	0,235 8	0,235 3
0,74	0,234 8	0,234 4	0,233 9	0,233 4	0,232 9	0,232 4	0,232 0	0,231 5	0,231 0	0,230 5
0,75	0,230 1	0,229 6	0,229 1	0,228 6	0,228 1	0,227 6	0,227 2	0,226 7	0,226 2	0,225 7
0,76	0,225 2	0,224 7	0,224 2	0,223 7	0,223 2	0,222 7	0,222 2	0,221 7	0,221 3	0,220 8
0,77	0,220 3	0,219 8	0,219 3	0,218 8	0,218 3	0,217 7	0,217 2	0,216 7	0,216 2	0,215 7
0,78	0,215 2	0,214 7	0,214 2	0,213 7	0,213 2	0,212 7	0,212 1	0,211 6	0,211 1	0,210 6
0,79	0,210 1	0,209 6	0,209 0	0,208 5	0,208 0	0,207 5	0,206 9	0,206 4	0,205 9	0,205 4
0,80	0,204 8	0,204 3	0,203 8	0,203 2	0,202 7	0,202 2	0,201 6	0,201 1	0,200 6	0,200 0
0,81	0,199 5	0,198 9	0,198 4	0,197 8	0,197 3	0,196 7	0,196 2	0,195 6	0,195 1	0,194 5
0,82	0,194 0	0,193 4	0,192 9	0,192 3	0,191 7	0,191 2	0,190 6	0,190 0	0,189 5	0,188 9
0,83	0,188 3	0,187 8	0,187 2	0,186 6	0,186 0	0,185 5	0,184 9	0,184 3	0,183 7	0,183 1
0,84	0,182 6	0,182 0	0,181 4	0,180 8	0,180 2	0,179 6	0,179 0	0,178 4	0,177 8	0,177 2
0,85	0,176 6	0,176 0	0,175 4	0,174 8	0,174 2	0,173 6	0,172 9	0,172 3	0,171 7	0,171 1
0,86	0,170 5	0,169 8	0,169 2	0,168 6	0,168 0	0,167 3	0,166 7	0,166 0	0,165 4	0,164 8
0,87	0,164 1	0,163 5	0,162 8	0,162 2	0,161 5	0,160 9	0,160 2	0,159 5	0,158 9	0,158 2
0,88	0,157 5	0,156 9	0,156 2	0,155 5	0,154 8	0,154 2	0,153 5	0,152 8	0,152 1	0,151 4
0,89	0,150 7	0,150 0	0,149 3	0,148 6	0,147 9	0,147 2	0,146 5	0,145 7	0,145 0	0,144 3
0,90	0,143 6	0,142 8	0,142 1	0,141 4	0,140 6	0,139 9	0,139 1	0,138 4	0,137 6	0,136 8
0,91	0,136 1	0,135 3	0,134 5	0,133 8	0,133 0	0,132 2	0,131 4	0,130 6	0,129 8	0,129 0
0,92	0,128 2	0,127 4	0,126 6	0,125 7	0,124 9	0,124 1	0,123 2	0,122 4	0,121 5	0,120 7
0,93	0,119 8	0,118 9	0,118 1	0,117 2	0,116 3	0,115 4	0,114 5	0,113 6	0,112 7	0,111 8
0,94	0,110 8	0,109 9	0,108 9	0,108 0	0,107 0	0,106 1	0,105 1	0,104 1	0,103 1	0,102 1
0,95	0,101 1	0,100 1	0,099 0	0,098 0	0,096 9	0,095 9	0,094 8	0,093 7	0,092 6	0,091 5
0,96	0,090 3	0,089 2	0,088 0	0,086 9	0,085 7	0,084 5	0,083 2	0,082 0	0,080 7	0,079 5
0,97	0,078 2	0,076 8	0,075 5	0,074 1	0,072 7	0,071 3	0,069 9	0,068 4	0,066 9	0,065 3
0,98	0,063 8	0,062 1	0,060 5	0,058 8	0,057 0	0,055 2	0,053 3	0,051 4	0,049 4	0,047 3
0,99	0,045 1	0,042 7	0,040 3	0,037 7	0,034 9	0,031 8	0,028 5	0,024 7	0,020 1	0,014 2
1,00	0,000 0	0,000 0	0,000 0	0,000 0	0,000 0	0,000 0	0,000 0	0,000 0	0,000 0	0,000 0

NOTE For negative values of Q, enter the table with the absolute value of $\sqrt{3}Q/2$ and subtract the result from 1,0.

Table 23 — Form p^* double sampling plans for normal inspection (master table): "s" method

Sample size code letter	Acceptance quality limit (in percent nonconforming)															
	0,01	0,015	0,025	0,04	0,065	0,10	0,15	0,25	0,40	0,65	1,0	1,5	2,5	4,0	6,5	10,0
	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$
B	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	**3, 0**	**2, 0**	↓
C	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	*3* *19, 25*	4 5,267 26,27 12,43	4 8,600 29,10 16,22	3 20,29 43,08 30,52
D	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	*4* *8, 600*	6 3,439 15,64 7,656	6 4,875 17,79 9,933	4 10,03 30,33 17,92	4 23,80 43,37 30,68
E	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	*6* *5, 220*	9 2,100 8,964 4,839	9 2,840 10,40 6,222	6 5,379 18,49 10,57	6 13,26 28,29 18,35	6 20,79 36,87 26,11
F	↓	↓	↓	↓	↓	↓	↓	↓	↓	8 0,0484 3,364 2,429	11 1,299 5,958 2,986	11 1,750 6,994 3,808	8 3,241 12,07 6,586	9 7,910 18,19 11,77	9 12,72 24,40 16,73	8 22,85 37,10 26,47
G	↓	↓	↓	↓	↓	↓	↓	↓	10 0,0608 2,000 1,466	14 0,7899 3,701 1,820	15 1,070 4,190 2,410	12 1,947 6,950 4,259	13 4,663 11,31 7,243	13 7,601 15,57 10,23	13 13,64 23,33 16,38	13 19,64 30,41 22,59
H	↓	↓	↓	↓	↓	↓	↓	12 0,0493 1,237 0,8866	18 0,5019 2,288 1,178	19 0,6695 2,641 1,528	15 1,198 4,492 2,624	17 2,877 7,338 4,532	18 4,693 10,02 6,464	20 8,393 14,77 10,43	20 12,23 19,63 14,36	20 18,01 26,44 20,31
J	↓	↓	↓	↓	↓	↓	15 0,0408 0,7317 0,5711	23 0,3111 1,382 0,7497	24 0,4121 1,617 0,9541	20 0,7326 2,698 1,658	23 1,744 4,519 2,817	25 2,847 6,216 4,010	28 5,130 9,344 6,452	30 7,474 12,30 8,907	31 11,05 16,65 12,63	32 15,83 22,15 17,59
K	↓	↓	↓	↓	↓	18 0,0296 0,4508 0,3651	28 0,1980 0,8677 0,4799	29 0,2600 1,025 0,6054	25 0,4601 1,695 1,057	30 1,090 2,841 1,802	33 1,779 3,947 2,557	39 3,210 5,916 4,125	42 4,701 7,875 5,681	45 6,957 10,70 8,034	48 10,00 14,26 11,21	49 15,41 20,46 16,76
L	↓	↓	↓	↓	22 0,0210 0,2683 0,2399	33 0,1220 0,5412 0,2941	36 0,1611 0,6233 0,3840	31 0,2835 1,041 0,6570	38 0,6686 1,759 1,123	43 1,091 2,448 1,594	51 1,982 3,725 2,561	57 2,897 4,939 3,537	64 4,296 6,675 5,014	69 6,193 8,965 6,982	75 9,525 12,84 10,45	↑
M	↓	↓	↓	26 0,0143 0,1647 0,1542	39 0,0767 0,3392 0,1865	42 0,1014 0,3956 0,2390	37 0,1777 0,6573 0,4140	47 0,4180 1,107 0,7118	54 0,6849 1,545 1,009	66 1,245 2,354 1,623	75 1,822 3,126 2,242	86 2,703 4,235 3,175	96 3,897 5,691 4,426	107 6,007 8,180 6,613	↑	↑
N	↓	↓	30 0,0093 0,1017 0,0951	46 0,0481 0,2108 0,1179	50 0,0634 0,2448 0,1521	45 0,1112 0,4059 0,2623	57 0,2607 0,6935 0,4462	67 0,4257 0,9648 0,6360	83 0,7763 1,478 1,021	96 1,139 1,967 1,408	112 1,689 2,675 1,997	128 2,441 3,593 2,781	148 3,766 5,159 4,164	↑	↑	↑
P	↓	35 0,0061 0,0618 0,0606	54 0,0301 0,1294 0,0740	59 0,0393 0,1509 0,0953	53 0,0689 0,2514 0,1632	68 0,1616 0,4324 0,2782	82 0,2642 0,5981 0,3969	103 0,4810 0,9228 0,6372	122 0,7054 1,223 ,8814	144 1,049 1,666 1,248	166 1,519 2,247 1,736	198 2,344 3,225 2,598	↑	↑	↑	↑
Q	41 0,0041 0,0382 0,0408	62 0,0191 0,0819 0,0476	68 0,0251 0,0954 0,0611	62 0,0438 0,1586 0,1049	81 0,1023 0,2733 0,1784	97 0,1679 0,3822 0,2540	125 0,3063 0,5864 0,4073	147 0,4500 0,7868 0,5626	178 0,6682 1,067 0,7972	209 0,9679 1,437 1,110	254 1,493 2,066 1,664	↑	↑	↑	↑	↑
R	71 0,0119 0,0507 0,029	78 0,0156 0,0591 0,0383	71 0,0272 0,0987 0,0652	94 0,0637 0,1709 0,1110	115 0,1042 0,2378 0,1584	149 0,1902 0,3670 0,2546	179 0,2795 0,4889 0,3510	218 0,4169 0,6669 0,4978	260 0,6022 0,8978 0,6947	322 0,9303 1,291 1,039	↑	↑	↑	↑	↑	↑

NOTE 1 The sample size code letters in this part of ISO 3951 correspond to those given in ISO 2859-1, ISO 3951-1 and ISO 3951-2.

NOTE 2 Symbols: ↓ There is no suitable plan in this area; use the first sampling plan below the arrow. If the sample size equals or exceeds the lot size, carry out 100 % inspection.

↑ There is no suitable plan in this area; use the first sampling plan above the arrow.

NOTE 3 Numbers in bold type indicate single sampling plan by attributes of the form n, Ac.

NOTE 4 Numbers in italics indicate single sampling plans by variables of the form n, $100p^*$.

Table 24 — Form p^* double sampling plans for tightened inspection (master table) — "s" method

Sample size code letter	Acceptance quality limit (in percent nonconforming)															
	0,01	0,015	0,025	0,04	0,065	0,10	0,15	0,25	0,40	0,65	1,0	1,5	2,5	4,0	6,5	10,0
	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$
B	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	**3, 0**	**2, 1**	↓
C	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	*3* *19, 25*	4 5,267 26,27 12,43	4 8,600 29,10 16,22
D	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	*4* *8, 600*	6 3,439 15,64 7,656	6 4,875 17,79 9,933	4 10,03 30,33 17,92
E	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	*6* *5, 220*	9 2,100 8,964 4,839	9 2,840 10,40 6,222	6 5,379 18,49 10,57	6 13,26 28,29 18,35
F	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	8 0,0484 3,364 2,429	11 1,299 5,958 2,986	11 1,750 6,994 3,808	8 3,241 12,07 6,586	9 7,910 18,19 11,77	9 12,72 24,40 16,73
G	↓	↓	↓	↓	↓	↓	↓	↓	↓	10 0,0608 2,000 1,466	14 0,7899 3,701 1,820	15 1,070 4,190 2,410	12 1,947 6,950 4,259	13 4,663 11,31 7,243	13 7,601 15,57 10,23	13 13,64 23,33 16,38
H	↓	↓	↓	↓	↓	↓	↓	↓	12 0,0493 1,237 0,8866	18 0,5019 2,288 1,178	19 0,6695 2,641 1,528	15 1,198 4,492 2,624	17 2,877 7,338 4,532	18 4,693 10,02 6,464	20 8,393 14,77 10,43	20 14,16 21,95 16,33
J	↓	↓	↓	↓	↓	↓	↓	15 0,0408 0,7317 0,5711	23 0,3111 1,382 0,7497	24 0,4121 1,617 0,9541	20 0,7326 2,698 1,658	23 1,744 4,519 2,817	25 2,847 6,216 4,010	28 5,130 9,344 6,452	31 8,634 13,69 10,17	32 13,42 19,36 15,10
K	↓	↓	↓	↓	↓	↓	18 0,0296 0,4508 0,3651	28 0,1980 0,8677 0,4799	29 0,2600 1,025 0,6054	25 0,4601 1,695 1,057	30 1,090 2,841 1,802	33 1,779 3,947 2,557	39 3,210 5,916 4,125	43 5,458 8,842 6,466	47 8,463 12,47 9,622	49 13,08 17,80 14,38
L	↓	↓	↓	↓	↓		33 0,1220 0,5412 0,2941	36 0,1611 0,6233 0,3840	31 0,2835 1,041 0,6570	38 0,6686 1,759 1,123	43 1,091 2,448 1,594	51 1,982 3,725 2,561	60 3,360 5,507 4,027	67 5,240 7,818 5,996	73 8,096 11,18 8,966	↑
M	↓	↓	↓	↓	26 0,0143 0,1647 0,1542	39 0,0767 0,3392 0,1865	42 0,1014 0,3956 0,2390	37 0,1777 0,6573 0,4140	47 0,4180 1,107 0,7118	54 0,6849 1,545 1,009	66 1,245 2,354 1,623	79 2,111 3,505 2,554	91 3,294 4,979 3,801	103 5,095 7,117 5,684	↑	↑
N	↓	↓	↓	30 0,0093 0,1017 0,0951	46 0,0481 0,2108 0,1179	50 0,0634 0,2448 0,1521	45 0,1112 0,4059 0,2623	57 0,2607 0,6935 0,4462	67 0,4257 0,9648 0,6360	83 0,7763 1,478 1,021	102 1,322 2,204 1,604	121 2,060 3,133 2,391	140 3,193 4,497 3,572	↑	↑	↑
P	↓	↓	35 0,0061 0,0618 0,0606	54 0,0301 0,1294 0,0740	59 0,0393 0,1509 0,0953	53 0,0689 0,2514 0,1632	68 0,1616 0,4324 0,2782	82 0,2642 0,5981 0,3969	103 0,4810 0,9228 0,6372	129 0,8213 1,378 1,001	155 1,283 1,961 1,491	185 1,989 2,814 2,226	↑	↑	↑	↑
Q	↓	41 0,0041 0,0382 0,0408	62 0,0191 0,0819 0,0476	68 0,0251 0,0954 0,0611	62 0,0438 0,1586 0,1049	81 0,1023 0,2733 0,1784	97 0,1679 0,3822 0,2540	125 0,3063 0,5864 0,4073	158 0,5224 0,8810 0,6400	196 0,8160 1,249 0,9546	234 1,269 1,801 1,425	↑	↑	↑	↑	↑
R	47 0,0026 0,0234 0,0258	71 0,0119 0,0507 0,0298	78 0,0156 0,0591 0,0383	71 0,0272 0,0987 0,0652	94 0,0637 0,1709 0,1110	115 0,1042 0,2378 0,1584	149 0,1902 0,3670 0,2546	191 0,3255 0,5507 0,3995	239 0,5098 0,7840 0,5951	297 0,7893 1,124 0,8903	↑	↑	↑	↑	↑	↑

NOTE 1 The sample size code letters in this part of ISO 3951 correspond to those given in ISO 2859-1, ISO 3951-1 and ISO 3951-2.

NOTE 2 Symbols:

↓ There is no suitable plan in this area; use the first sampling plan below the arrow. If the sample size equals or exceeds the lot size, carry out 100 % inspection.

↑ There is no suitable plan in this area; use the first sampling plan above the arrow.

NOTE 3 Numbers in bold type indicate single sampling plan by attributes of the form n, Ac.

NOTE 4 Numbers in italics indicate single sampling plans by variables of the form n, $100p^*$.

Table 25 — Form p^* double sampling plans for reduced inspection (master table) — "s" method

Sample size code letter	Acceptance quality limit (in percent nonconforming)															
	0,01	0,015	0,025	0,04	0,065	0,10	0,15	0,25	0,40	0,65	1,0	1,5	2,5	4,0	6,5	10,0
	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$
B, C	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	**2, 0**	**3, 1**	↓
D	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	**3, 0**	**2, 0**	**8, 1**	**5, 1**	**3, 1**
E	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	*3* *19, 25*	4 1,833 23,40 9,918	4 5,267 26,27 12,43	4 8,600 29,10 16,22	3 20,29 43,08 30,52	3 38,42 61,35 47,94
F	↓	↓	↓	↓	↓	↓	↓	↓	↓	*4* *8, 600*	6 2,175 13,52 6,206	6 3,439 15,64 7,656	6 4,875 17,79 9,933	4 10,03 30,33 17,92	4 23,80 43,37 30,68	3 38,80 61,97 42,24
G	↓	↓	↓	↓	↓	↓	↓	↓	*6* *5, 220*	8 1,339 8,250 3,696	9 2,100 8,964 4,839	9 2,840 10,40 6,222	6 5,379 18,49 10,57	6 13,26 28,29 18,35	6 20,79 36,87 26,11	5 36,37 56,25 40,88
H	↓	↓	↓	↓	↓	↓	↓	8 0,0484 3,364 2,429	10 0,8528 5,341 2,331	10 1,299 5,958 2,986	11 1,750 6,994 3,808	8 3,241 12,07 6,586	9 7,910 18,19 11,77	9 12,72 24,40 16,73	8 22,85 37,10 26,47	8 27,58 42,46 31,43
J	↓	↓	↓	↓	↓	↓	10 0,0608 2,000 1,466	13 0,5398 3,221 1,448	14 07899 3,701 1,820	15 1,070 4,190 2,410	12 1,947 6,950 4,259	13 4,663 11,31 7,243	13 7,601 15,57 10,23	13 13,64 23,33 16,38	13 16,65 26,92 19,48	13 22,62 33,81 25,69
K	↓	↓	↓	↓	↓	12 0,0493 1,237 0,8866	16 0,3424 2,031 0,9135	18 0,5019 2,288 1,178	19 0,6695 2,641 1,528	15 1,198 4,492 2,624	17 2,877 7,338 4,532	18 4,693 10,02 6,464	20 8,393 14,77 10,43	20 10,30 17,24 12,38	20 14,16 21,95 16,33	20 18,01 26,44 20,31
L	↓	↓	↓	↓	15 0,0408 0,7317 0,5711	19 0,2090 1,273 0,5520	23 0,3111 1,382 0,7497	24 0,4121 1,617 0,9541	20 0,7326 2,698 1,658	23 1,744 4,519 2,817	25 2,847 6,216 4,010	28 5,130 9,344 6,452	29 6,296 10,85 7,688	31 8,634 13,69 10,17	31 11,05 16,65 12,63	↑
M	↓	↓	↓	18 0,0296 0,4508 0,3651	23 0,1345 0,7969 0,3544	28 0,1980 0,8677 0,4799	29 0,2600 1,025 0,6054	25 0,4601 1,695 1,057	30 1,090 2,841 1,802	33 1,779 3,947 2,557	39 3,210 5,916 4,125	40 3,958 6,954 4,895	43 5,458 8,842 6,466	45 6,957 10,70 8,034	↑	↑
N	↓	↓	22 0,0210 0,2683 0,2399	28 0,0847 0,4839 0,2240	33 0,1220 0,5412 0,2941	36 0,1611 0,6233 0,3840	31 0,2835 1,041 0,6570	38 0,6686 1,759 1,123	43 1,091 2,448 1,594	51 1,982 3,725 2,561	55 2,433 4,313 3,055	60 3,360 5,507 4,027	64 4,296 6,675 5,014	↑	↑	↑
P	↓	26 0,0143 0,1647 0,1542	33 0,0536 0,3022 0,1422	39 0,0767 0,3392 0,1865	42 0,1014 0,3956 0,2390	37 0,1777 0,6573 0,4140	47 0,4180 1,107 0,7118	54 0,6849 1,545 1,009	66 1,245 2,354 1,623	71 1,529 2,740 1,932	79 2,111 3,505 2,554	86 2,703 4,235 3,175	↑	↑	↑	↑
Q	30 0,0093 0,1017 0,0951	38 0,0335 0,1896 0,0887	46 0,0481 0,2108 0,1179	50 0,0634 0,2448 0,1521	45 0,1112 0,4059 0,2623	57 0,2607 0,6935 0,4462	67 0,4257 0,9648 0,6360	83 0,7763 1,478 1,021	90 0,9575 1,727 1,213	102 1,322 2,204 1,604	112 1,689 2,675 1,997	↑	↑	↑	↑	↑
R	44 0,0210 0,1169 0,0552	54 0,0301 0,1294 0,0740	59 0,0393 0,1509 0,0953	53 0,0689 0,2514 0,1632	68 0,1616 0,4324 0,2782	82 0,2642 0,5981 0,3969	103 0,4810 0,9228 0,6372	112 0,5931 1,078 0,7583	129 0,8213 1,378 1,001	144 1,049 1,666 1,248	↑	↑	↑	↑	↑	↑

NOTE 1 The sample size code letters in this part of ISO 3951 correspond to those given in ISO 2859-1, ISO 3951-1 and ISO 3951-2.

NOTE 2 Symbols:

↓ There is no suitable plan in this area; use the first sampling plan below the arrow. If the sample size equals or exceeds the lot size, carry out 100 % inspection.

↑ There is no suitable plan in this area; use the first sampling plan above the arrow.

NOTE 3 Numbers in bold type indicate single sampling plan by attributes of the form n, Ac.

NOTE 4 Numbers in italics indicate single sampling plans by variables of the form n, $100p^*$.

Table 26 — Form p^* double sampling plans for normal inspection (master table) —"σ" method

Sample size code letter	Acceptance quality limit (in percent nonconforming)															
	0,01	0,015	0,025	0,04	0,065	0,10	0,15	0,25	0,40	0,65	1,0	1,5	2,5	4,0	6,5	10,0
	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$
B	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	**3, 0**	**2, 0**	↓
C	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	*3* *19, 25*	3 5,267 26,27 12,43	3 8,600 29,10 16,22	2 20,29 43,08 30,52
D	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	*4* *8, 600*	3 3,439 15,64 7,656	4 4,875 17,79 9,933	3 10,03 30,33 17,92	3 23,80 43,37 30,68
E	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	*6* *5, 220*	4 2,100 8,964 4,839	4 2,840 10,40 6,222	4 5,379 18,49 10,57	5 13,26 28,29 18,35	4 20,79 36,87 26,11
F	↓	↓	↓	↓	↓	↓	↓	↓	↓	3 0,0484 3,364 2,429	4 1,299 5,958 2,986	5 1,750 6,994 3,808	4 3,241 12,07 6,586	6 7,910 18,19 11,77	7 12,72 24,40 16,73	6 22,85 37,10 26,47
G	↓	↓	↓	↓	↓	↓	↓	↓	3 0,0608 2,000 1,466	5 ,7899 3,701 1,820	6 1,070 4,190 2,410	5 1,947 6,950 4,259	7 4,663 11,31 7,243	8 7,601 15,57 10,23	10 13,64 23,33 16,38	9 19,64 30,41 22,59
H	↓	↓	↓	↓	↓	↓	↓	3 0,0493 1,237 0,8866	6 0,5019 2,288 1,178	6 0,6695 2,641 1,528	6 1,198 4,492 2,624	8 2,877 7,338 4,532	10 4,693 10,02 6,464	12 8,393 14,77 10,43	12 12,23 19,63 14,36	14 18,01 26,44 20,31
J	↓	↓	↓	↓	↓	↓	4 0,0408 0,7317 0,5711	6 0,3111 1,382 0,7497	7 ,4121 1,617 ,9541	7 ,7326 2,698 1,658	9 1,744 4,519 2,817	11 2,847 6,216 4,010	15 5,130 9,344 6,452	17 7,474 12,30 8,907	17 11,05 16,65 12,63	21 15,83 22,15 17,59
K	↓	↓	↓	↓	↓	4 0,0296 0,4508 0,3651	7 0,1980 0,8677 0,4799	8 0,2600 1,025 0,6054	7 0,4601 1,695 1,057	10 1,090 2,841 1,802	13 1,779 3,947 2,557	17 3,210 5,916 4,125	21 4,701 7,875 5,681	21 6,957 10,70 8,034	26 10,00 14,26 11,21	32 15,41 20,46 16,76
L	↓	↓	↓	↓	5 0,0210 0,2683 0,2399	7 0,1220 0,5412 0,2941	8 0,1611 0,6233 0,3840	8 0,2835 1,041 0,6570	12 0,6686 1,759 1,123	14 1,091 2,448 1,594	20 1,982 3,725 2,561	24 2,897 4,939 3,537	25 4,296 6,675 5,014	31 6,193 8,965 6,982	39 9,525 12,84 10,45	↑
M	↓	↓	↓	5 0,0143 0,1647 0,1542	8 0,0767 0,3392 0,1865	9 0,1014 0,3956 0,2390	9 0,1777 0,6573 0,4140	13 0,4180 1,107 0,7118	16 0,6849 1,545 1,009	22 1,245 2,354 1,623	27 1,822 3,126 2,242	31 2,703 4,235 3,175	36 3,897 5,691 4,426	47 6,007 8,180 6,613	↑	↑
N	↓	↓	6 0,0093 0,1017 0,0951	9 0,0481 0,2108 0,1179	10 0,0634 0,2448 0,1521	10 0,1112 0,4059 0,2623	14 0,2607 0,6935 0,4462	18 0,4257 0,9648 0,6360	25 0,7763 1,478 1,021	31 1,139 1,967 1,408	38 1,689 2,675 1,997	42 2,441 3,593 2,781	56 3,766 5,159 4,164	↑	↑	↑
P	↓	6 0,0061 0,0618 0,0606	10 0,0301 0,1294 0,0740	11 0,0393 0,1509 0,0953	11 0,0689 0,2514 0,1632	15 0,1616 0,4324 0,2782	19 0,2642 0,5981 0,3969	27 0,4810 0,9228 0,6372	34 0,7054 1,223 0,8814	44 1,049 1,666 1,248	48 1,519 2,247 1,736	65 2,344 3,225 2,598	↑	↑	↑	↑
Q	7 0,0041 0,0382 0,0408	10 0,0191 0,0819 0,0476	12 0,0251 0,0954 0,0611	11 0,0438 0,1586 0,1049	16 0,1023 0,2733 0,1784	21 0,1679 0,3822 0,2540	30 0,3063 0,5864 0,4073	38 0,4500 0,7868 0,5626	48 0,6682 1,067 0,7972	54 0,9679 1,437 1,110	73 1,493 2,066 1,664	↑	↑	↑	↑	↑
R	11 0,0119 0,0507 0,0298	12 0,0156 0,0591 0,0383	12 0,0272 0,0987 0,0652	18 0,0637 0,1709 0,1110	23 0,1042 0,2378 0,1584	32 0,1902 0,3670 0,2546	41 0,2795 0,4889 0,3510	53 0,4169 0,6669 0,4978	60 0,6022 0,8978 0,6947	83 0,9303 1,291 1,039	↑	↑	↑	↑	↑	↑

NOTE 1 The sample size code letters in this part of ISO 3951 correspond to those given in ISO 2859-1, ISO 3951-1and ISO 3951-2.

NOTE 2 Symbols: ↓ There is no suitable plan in this area; use the first sampling plan below the arrow. If the sample size equals or exceeds the lot size, carry out 100 % inspection.

↑ There is no suitable plan in this area; use the first sampling plan above the arrow.

NOTE 3 Numbers in bold type indicate single sampling plan by attributes of the form n, Ac.

NOTE 4 Numbers in italics indicate single sampling plans by variables of the form n, $100p^*$.

Table 27 — Form p^* double sampling plans for tightened inspection (master table) — "σ" method

Sample size code letter	Acceptance quality limit (in percent nonconforming)															
	0,01	0,015	0,025	0,04	0,065	0,10	0,15	0,25	0,40	0,65	1,0	1,5	2,5	4,0	6,5	10,0
	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$
B	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	**3, 0**	**2, 1**	↓
C	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	*3* *19, 25*	3 5,267 26,27 12,43	3 8,600 29,10 16,22
D	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	*4* *8, 600*	3 3,439 15,64 7,656	4 4,875 17,79 9,933	3 10,03 30,33 17,92
E	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	*6* *5, 220*	4 2,100 8,964 4,839	4 2,840 10,40 6,222	4 5,379 18,49 10,57	5 13,26 28,29 18,35
F	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	3 0,0484 3,364 2,429	4 1,299 5,958 2,986	5 1,750 6,994 3,808	4 3,241 12,07 6,586	6 7,910 18,19 11,77	7 12,72 24,40 16,73
G	↓	↓	↓	↓	↓	↓	↓	↓	↓	3 0,0608 2,000 1,466	5 0,7899 3,701 1,820	6 1,070 4,190 2,410	5 1,947 6,950 4,259	7 4,663 11,31 7,243	8 7,601 15,57 10,23	10 13,64 23,33 16,38
H	↓	↓	↓	↓	↓	↓	↓	↓	3 0,0493 1,237 0,8866	6 0,5019 2,288 1,178	6 0,6695 2,641 1,528	6 1,198 4,492 2,624	8 2,877 7,338 4,532	10 4,693 10,02 6,464	12 8,393 14,77 10,43	13 14,16 21,95 16,33
J	↓	↓	↓	↓	↓	↓	↓	4 0,0408 0,7317 0,5711	6 0,3111 1,382 0,7497	7 0,4121 1,617 0,9541	7 0,7326 2,698 1,658	9 1,744 4,519 2,817	11 2,847 6,216 4,010	15 5,130 9,344 6,452	16 8,634 13,69 10,17	19 13,42 19,36 15,10
K	↓	↓	↓	↓	↓	↓	4 0,0296 0,4508 0,3651	7 0,1980 0,8677 0,4799	8 0,2600 1,025 0,6054	7 0,4601 1,695 1,057	10 1,090 2,841 1,802	13 1,779 3,947 2,557	17 3,210 5,916 4,125	22 5,458 8,842 6,466	24 8,463 12,47 9,622	29 13,08 17,80 14,38
L	↓	↓	↓	↓	↓	5 0,0210 0,2683 0,2399	7 0,1220 0,5412 0,2941	8 0,1611 0,6233 0,3840	8 0,2835 1,041 0,6570	12 0,6686 1,759 1,123	14 1,091 2,448 1,594	20 1,982 3,725 2,561	26 3,360 5,507 4,027	28 5,240 7,818 5,996	36 8,096 11,18 8,966	↑
M	↓	↓	↓	↓	5 0,0143 0,1647 0,1542	8 0,0767 0,3392 0,1865	9 0,1014 0,3956 0,2390	9 0,1777 0,6573 0,4140	13 0,4180 1,107 0,7118	16 0,6849 1,545 1,009	22 1,245 2,354 1,623	30 2,111 3,505 2,554	33 3,294 4,979 3,801	43 5,095 7,117 5,684	↑	↑
N	↓	↓	↓	6 0,0093 0,1017 0,0951	9 0,0481 0,2108 0,1179	10 0,0634 0,2448 0,1521	10 0,1112 0,4059 0,2623	14 0,2607 0,6935 0,4462	18 0,4257 0,9648 0,6360	25 0,7763 1,478 1,021	34 1,322 2,204 1,604	38 2,060 3,133 2,391	50 3,193 4,497 3,572	↑	↑	↑
P	↓	↓	6 0,0061 0,0618 0,0606	10 0,0301 0,1294 0,0740	11 0,0393 0,1509 0,0953	11 0,0689 0,2514 0,1632	15 0,1616 0,4324 0,2782	19 0,2642 0,5981 0,3969	27 0,4810 0,9228 0,6372	38 0,8213 1,378 1,001	43 1,283 1,961 1,491	58 1,989 2,814 2,226	↑	↑	↑	↑
Q	↓	7 0,0041 0,0382 0,0408	10 0,0191 0,0819 0,0476	12 0,0251 0,0954 0,0611	11 0,0438 0,1586 0,1049	16 0,1023 0,2733 0,1784	21 0,1679 0,3822 0,2540	30 0,3063 0,5864 0,4073	41 0,5224 0,8810 0,6400	49 0,8160 1,249 0,9546	65 1,269 1,801 1,425	↑	↑	↑	↑	↑
R	7 0,0026 0,0234 0,0258	11 0,0119 0,0507 0,0298	12 0,0156 0,0591 0,0383	12 0,0272 0,0987 0,0652	18 0,0637 0,1709 0,1110	23 0,1042 0,2378 0,1584	32 0,1902 0,3670 0,2546	45 0,3255 0,5507 0,3995	56 0,5098 0,7840 0,5951	74 0,7893 1,124 0,8903	↑	↑	↑	↑	↑	↑

NOTE 1 The sample size code letters in this part of ISO 3951 correspond to those given in ISO 2859-1, ISO 3951-1 and ISO 3951-2.

NOTE 2 Symbols: ↓ There is no suitable plan in this area; use the first sampling plan below the arrow. If the sample size equals or exceeds the lot size, carry out 100 % inspection.

↑ There is no suitable plan in this area; use the first sampling plan above the arrow.

NOTE 3 Numbers in bold type indicate single sampling plan by attributes of the form n, Ac.

NOTE 4 Numbers in italics indicate single sampling plans by variables of the form n, $100p^*$.

Table 28 — Form p^* double sampling plans for reduced inspection (master table) — "σ" method

Sample size code letter	Acceptance quality limit (in percent nonconforming)															
	0,01	0,015	0,025	0,04	0,065	0,10	0,15	0,25	0,40	0,65	1,0	1,5	2,5	4,0	6,5	10,0
	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$	n $100p_a^*$ $100p_r^*$ $100p_c^*$
B, C	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	**2, 0**	**3, 1**	↓
D	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	**3, 0**	**2, 0**	**8, 1**	**5, 1**	**3, 1**
E	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	*3* *19, 25*	2 1,833 23,40 9,918	3 5,267 26,27 12,43	3 8,600 29,10 16,22	2 20,29 43,08 30,52	3 38,42 61,35 47,94
F	↓	↓	↓	↓	↓	↓	↓	↓	↓	*4* *8 ,600*	3 2,175 13,52 6,206	3 3,439 15,64 7,656	4 4,875 17,79 9,933	3 10,03 30,33 17,92	3 23,80 43,37 30,68	3 38,80 61,97 42,24
G	↓	↓	↓	↓	↓	↓	↓	↓	*6* *5, 220*	3 1,339 8,250 3,696	4 2,100 8,964 4,839	4 2,840 10,40 6,222	4 5,379 18,49 10,57	5 13,26 28,29 18,35	4 20,79 36,87 26,11	5 36,37 56,25 40,88
H	↓	↓	↓	↓	↓	↓	↓	3 0,0484 3,364 2,429	4 0,8528 5,341 2,331	4 1,299 5,958 2,986	5 1,750 6,994 3,808	4 3,241 12,07 6,586	6 7,910 18,19 11,77	7 12,72 24,40 16,73	6 22,85 37,10 26,47	7 27,58 42,46 31,43
J	↓	↓	↓	↓	↓	↓	3 0,0608 2,000 1,466	4 0,5398 3,221 1,448	5 0,7899 3,701 1,820	6 1,070 4,190 2,410	5 1,947 6,950 4,259	7 4,663 11,31 7,243	8 7,601 15,57 10,23	10 13,64 23,33 16,38	9 16,65 26,92 19,48	10 22,62 33,81 25,69
K	↓	↓	↓	↓	↓	3 0,0493 1,237 0,8866	5 0,3424 2,031 0,9135	6 0,5019 2,288 1,178	6 0,6695 2,641 1,528	6 1,198 4,492 2,624	8 2,877 7,338 4,532	10 4,693 10,02 6,464	12 8,393 14,77 10,43	13 10,30 17,24 12,38	13 14,16 21,95 16,33	14 18,01 26,44 20,31
L	↓	↓	↓	↓	4 0,0408 0,7317 0,5711	5 0,2090 1,273 0,5520	6 0,3111 1,382 0,7497	7 0,4121 1,617 0,9541	7 0,7326 2,698 1,658	9 1,744 4,519 2,817	11 2,847 6,216 4,010	15 5,130 9,344 6,452	16 6,296 10,85 7,688	16 8,634 13,69 10,17	17 11,05 16,65 12,63	↑
M	↓	↓	↓	4 0,0296 0,4508 0,3651	5 0,1345 0,7969 0,3544	7 0,1980 0,8677 0,4799	8 0,2600 1,025 0,6054	7 0,4601 1,695 1,057	10 1,090 2,841 1,802	13 1,779 3,947 2,557	17 3,210 5,916 4,125	19 3,958 6,954 4,895	22 5,458 8,842 6,466	21 6,957 10,70 8,034	↑	↑
N	↓	↓	5 0,0210 0,2683 0,2399	6 0,0847 0,4839 0,2240	7 0,1220 0,5412 0,2941	8 0,1611 0,6233 0,3840	8 0,2835 1,041 0,6570	12 0,6686 1,759 1,123	14 1,091 2,448 1,594	20 1,982 3,725 2,561	22 2,433 4,313 3,055	26 3,360 5,507 4,027	25 4,296 6,675 5,014	↑	↑	↑
P	↓	5 0,0143 0,1647 0,1542	7 0,0536 0,3022 0,1422	8 0,0767 0,3392 0,1865	9 0,1014 0,3956 0,2390	9 0,1777 0,6573 0,4140	13 0,4180 1,107 0,7118	16 0,6849 1,545 1,009	22 1,245 2,354 1,623	25 1,529 2,740 1,932	30 2,111 3,505 2,554	31 2,703 4,235 3,175	↑	↑	↑	↑
Q	6 0,0093 0,1017 0,0951	7 0,0335 0,1896 0,0887	9 0,0481 0,2108 0,1179	10 0,0634 0,2448 0,1521	10 0,1112 0,4059 0,2623	14 0,2607 0,6935 0,4462	18 0,4257 0,9648 0,6360	25 0,7763 1,478 1,021	28 0,9575 1,727 1,213	34 1,322 2,204 1,604	38 1,689 2,675 1,997	↑	↑	↑	↑	↑
R	8 0,0210 0,1169 0,0552	10 0,0301 0,1294 0,0740	11 0,0393 0,1509 0,0953	11 0,0689 0,2514 0,1632	15 0,1616 0,4324 0,2782	19 0,2642 0,5981 0,3969	27 0,4810 0,9228 0,6372	31 0,5931 1,078 0,7583	38 0,8213 1,378 1,001	44 1,049 1,666 1,248	↑	↑	↑	↑	↑	↑

NOTE 1 The sample size code letters in this part of ISO 3951 correspond to those given in ISO 2859-1, ISO 3951-1 and ISO 3951-2.

NOTE 2 Symbols:

↓ There is no suitable plan in this area; use the first sampling plan below the arrow. If the sample size equals or exceeds the lot size, carry out 100 % inspection.

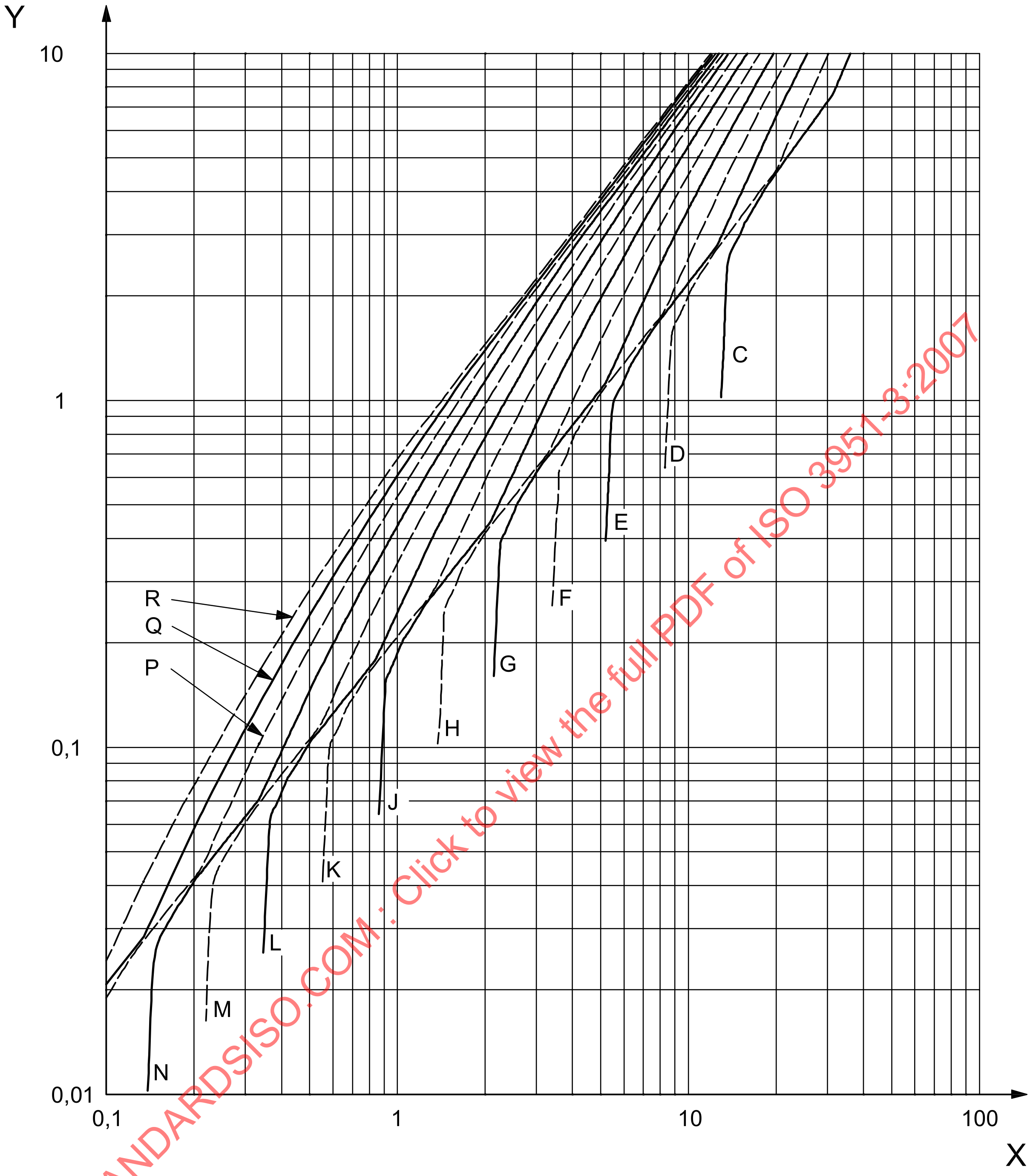
↑ There is no suitable plan in this area; use the first sampling plan above the arrow.

NOTE 3 Numbers in bold type indicate single sampling plan by attributes of the form n, Ac.

NOTE 4 Numbers in italics indicate single sampling plans by variables of the form n, $100p^*$.

Table 29 — Values of c_u for upper control limit of sample standard deviation

Sample size n	Factor c_u	Sample size n	Factor c_u	Sample size n	Factor c_u	Sample size n	Factor c_u
2	2,799 6	30	1,342 2	59	1,241 3	115	1,171 6
3	2,296 8	31	1,336 4	60	1,239 2	121	1,167 3
4	2,064 7	32	1,330 9	62	1,235 2	122	1,166 6
5	1,924 1	33	1,325 7	64	1,231 4	125	1,164 5
6	1,827 3	34	1,320 6	65	1,229 6	128	1,162 5
7	1,755 5	35	1,315 9	66	1,227 8	129	1,161 9
8	1,699 5	36	1,311 3	67	1,226 0	140	1,155 3
9	1,654 3	37	1,306 9	68	1,224 3	144	1,153 1
10	1,616 8	38	1,302 7	69	1,222 7	147	1,151 5
11	1,585 0	39	1,298 6	71	1,219 4	148	1,151 0
12	1,557 7	40	1,294 7	73	1,216 3	149	1,150 5
13	1,533 8	41	1,291 0	74	1,214 8	155	1,147 5
14	1,512 8	42	1,287 4	75	1,213 4	158	1,146 1
15	1,494 0	43	1,283 9	78	1,209 1	166	1,142 5
16	1,477 1	44	1,280 6	79	1,207 8	178	1,137 5
17	1,461 9	45	1,277 3	81	1,205 2	179	1,137 1
18	1,448 0	46	1,274 2	82	1,203 9	185	1,134 9
19	1,435 3	47	1,271 2	83	1,202 6	191	1,132 7
20	1,423 6	48	1,268 3	86	1,199 0	196	1,131 0
21	1,412 8	49	1,265 4	90	1,194 4	198	1,130 3
22	1,402 7	50	1,262 7	91	1,193 3	209	1,126 8
23	1,393 4	51	1,260 0	94	1,190 2	218	1,124 1
24	1,384 7	53	1,254 9	96	1,188 1	234	1,119 8
25	1,376 5	54	1,252 5	97	1,187 1	239	1,118 5
26	1,368 8	55	1,250 1	102	1,182 4	254	1,114 9
27	1,361 6	56	1,247 8	103	1,181 5	260	1,113 6
28	1,354 8	57	1,245 6	107	1,178 0	297	1,106 2
29	1,348 4	58	1,243 4	112	1,173 9	322	1,101 9



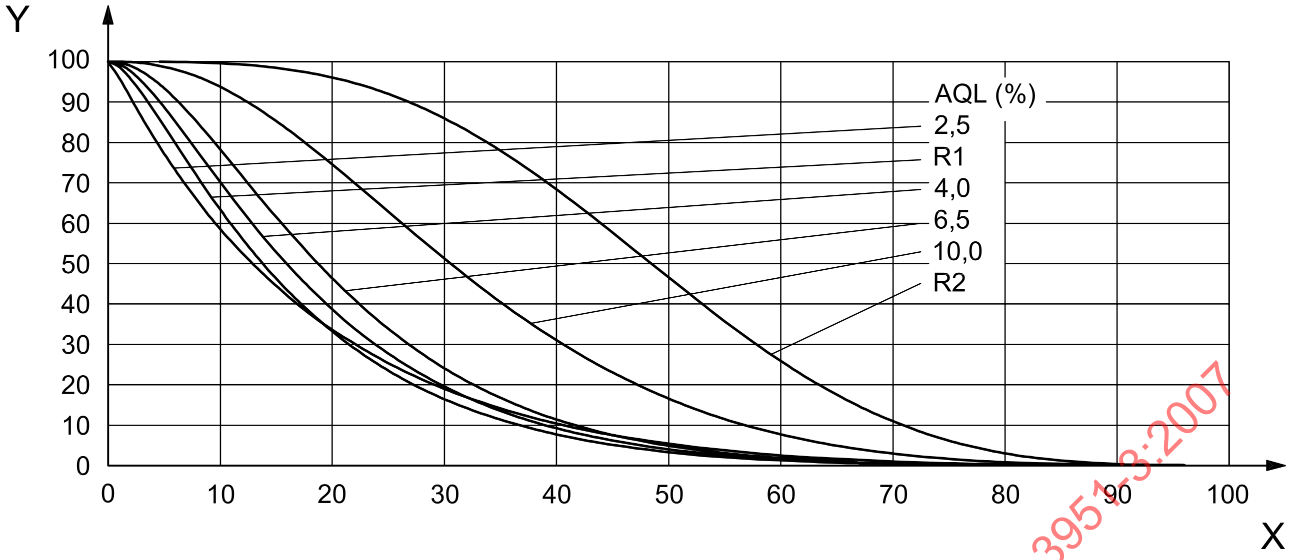
Key

X indifference quality, i.e. quality level at 50 % probability of acceptance (in percent nonconforming)

Y quality level at 95 % probability of acceptance, in percent nonconforming

C, D, E, etc. sample size code letters

Figure 1 — Chart A — Sample size code letters of standard double sampling plans for specified qualities at 95 % and 50 % probabilities of acceptance



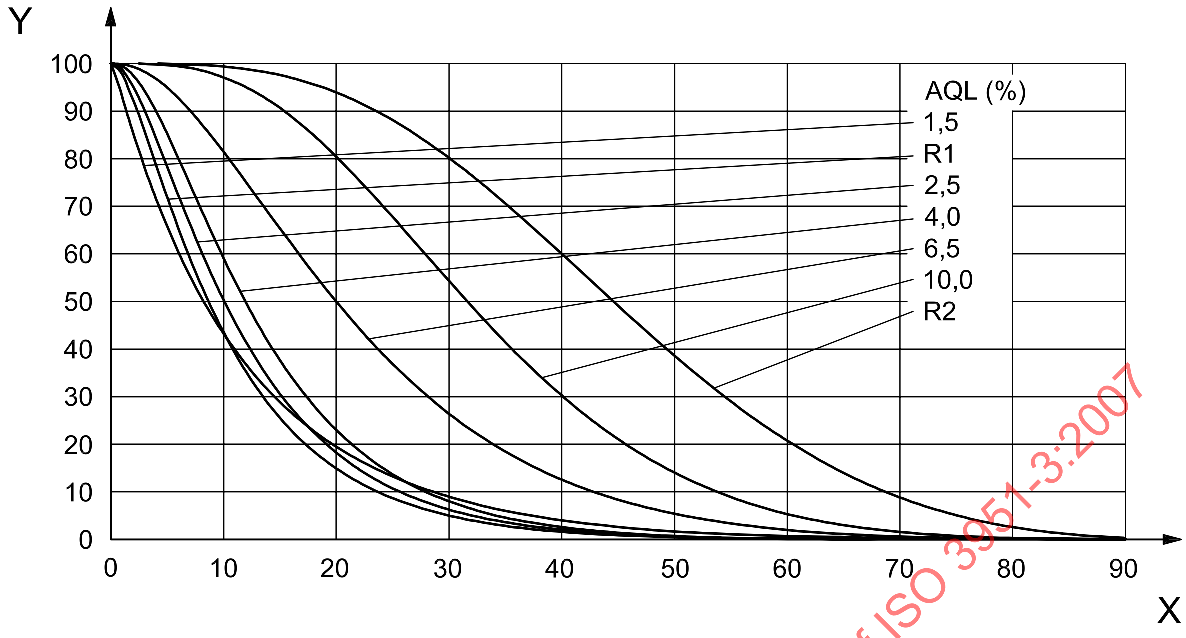
Key

X process quality (in percent nonconforming)

Y percentage of lots expected to be accepted

P_a %	Acceptance quality limit (normal inspection) in percent nonconforming — code letter C						P_a %
	2,5	R1	4,0	6,5	10,0	R2	
99,0	0,278	0,848	1,27	2,00	4,61	13,21	99,0
95,0	1,19	2,24	3,05	4,34	9,09	21,60	95,0
90,0	2,22	3,56	4,64	6,29	12,46	26,86	90,0
75,0	5,56	7,12	8,71	10,97	19,82	36,63	75,0
50,0	12,88	13,81	15,92	18,71	30,56	48,44	50,0
25,0	25,24	24,11	26,51	29,47	43,67	60,49	25,0
10,0	40,59	36,63	38,96	41,64	56,79	70,85	10,0
5,0	50,96	45,25	47,41	49,76	64,79	76,58	5,0
1,0	69,82	61,97	63,61	65,29	78,62	85,91	1,0
	4,0		6,5	10,0			
	Acceptance quality limit (tightened inspection) in percent nonconforming — code letter C						
	1,0	1,5	2,5	4,0	6,5	10,0	
	Acceptance quality limit (reduced inspection) in percent nonconforming — code letter E						

Figure 2 — Chart C — Operating characteristic curves for double sampling plans, normal inspection — Sample size code letter C, "s" method



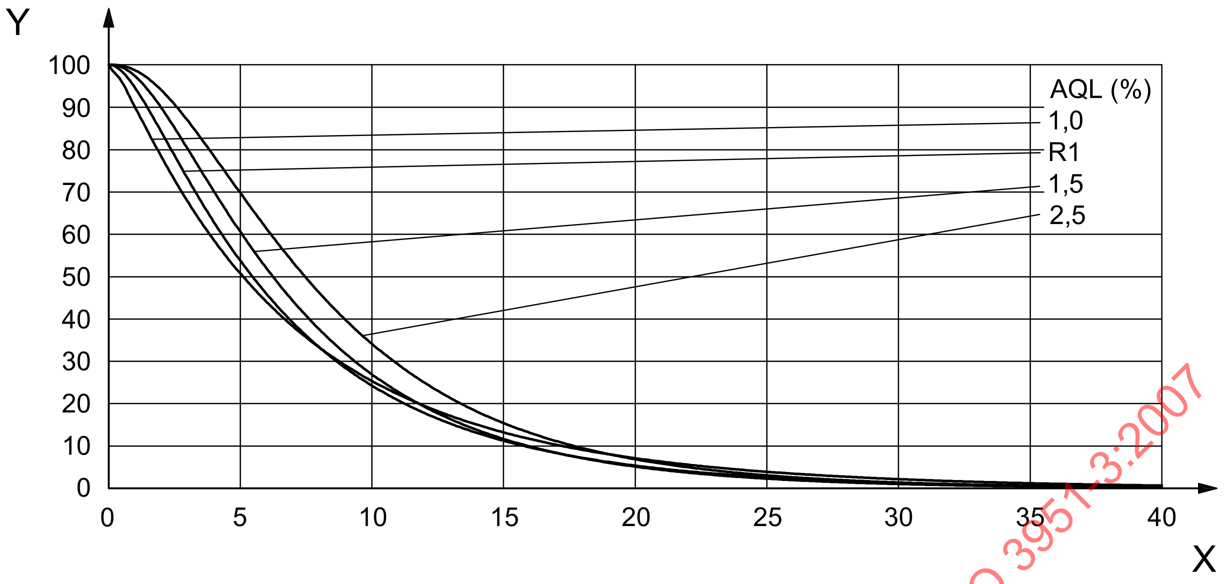
Key

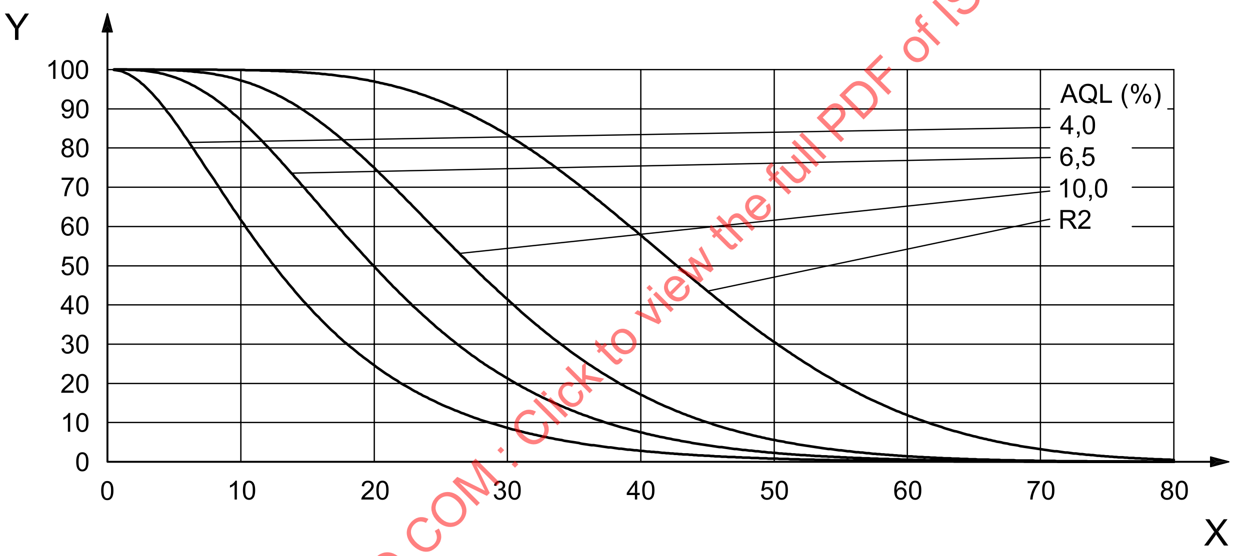
X process quality (in percent nonconforming)

Y percentage of lots expected to be accepted

P_a %	Acceptance quality limit (normal inspection) in percent nonconforming — code letter D							P_a %
	1,5	R1	2,5	4,0	6,5	10	R2	
99,0	0,182	0,633	0,894	1,32	2,38	7,17	11,54	99,0
95,0	0,753	1,54	2,04	2,80	4,99	12,05	18,81	95,0
90,0	1,39	2,37	3,03	4,02	7,09	15,40	23,57	90,0
75,0	3,49	4,56	5,56	6,97	12,04	22,24	32,81	75,0
50,0	8,25	8,67	10,08	11,95	19,99	31,63	44,61	50,0
25,0	16,84	15,21	16,98	19,18	30,80	42,72	57,32	25,0
10,0	28,58	23,70	25,68	27,95	42,83	53,78	68,72	10,0
5,0	37,32	30,05	32,07	34,26	50,81	60,67	75,16	5,0
1,0	55,74	44.00	45,88	47,77	66,02	73,25	85,53	1,0
	2,5		4,0	6,5	10,0			
	Acceptance quality limit (tightened inspection) in percent nonconforming — code letter D							
	0,65	1,0	1,5	2,5	4,0	6,5	10,0	
	Acceptance quality limit (reduced inspection) in percent nonconforming — code letter F							

Figure 3 — Chart D — Operating characteristic curves for double sampling plans, normal inspection — Sample size code letter D, "*s*" method





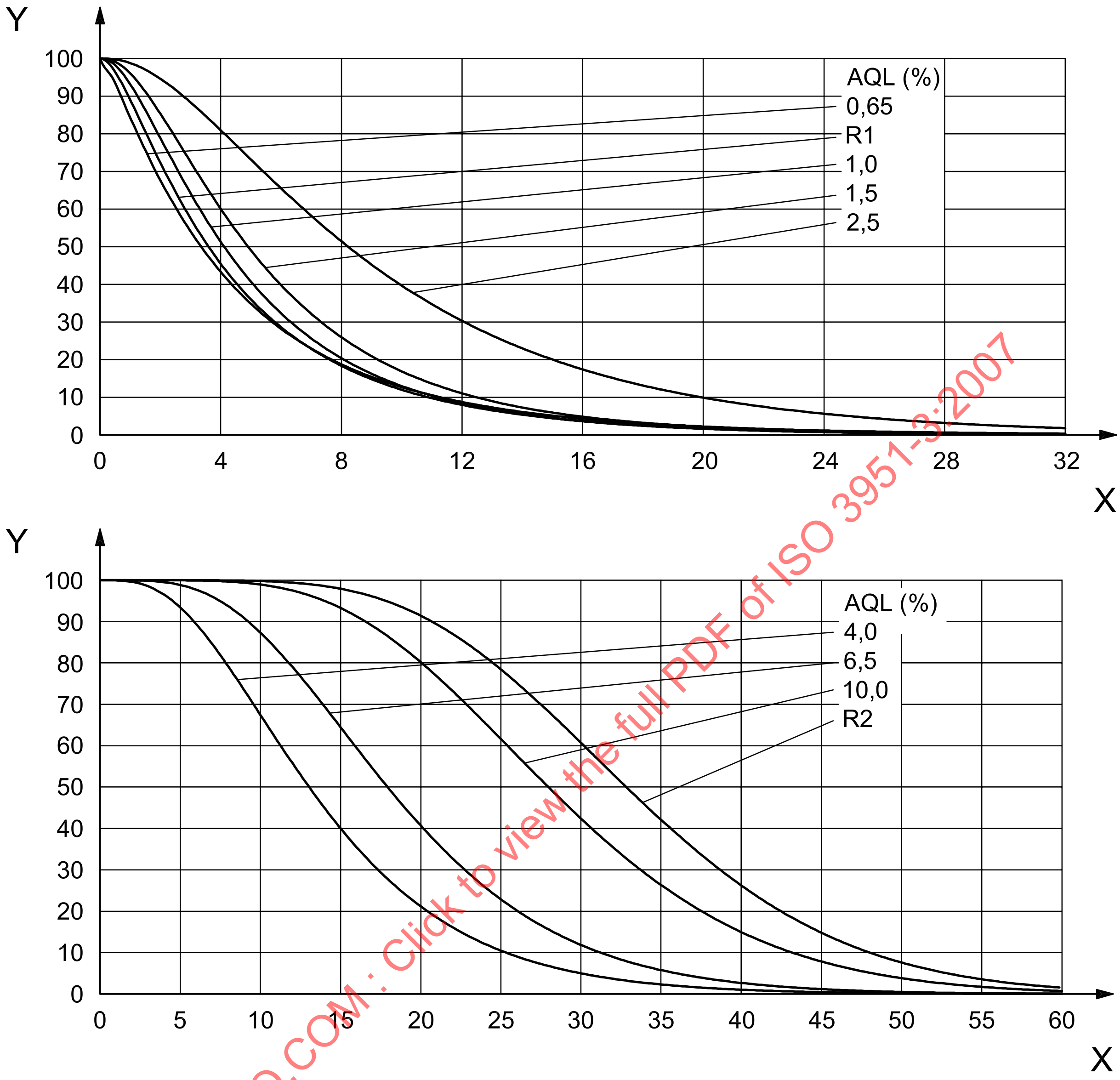
Key

X process quality (in percent nonconforming)

Y percentage of lots expected to be accepted

P_a %	Acceptance quality limit (normal inspection) in percent nonconforming — code letter E								P_a %
	1,0	R1	1,5	2,5	4,0	6,5	10,0	R2	
99,0	0,158	0,394	0,632	0,897	1,47	4,05	7,69	15,82	99,0
95,0	0,576	0,952	1,36	1,83	3,05	6,95	11,83	22,34	95,0
90,0	1,00	1,46	1,98	2,59	4,33	9,02	14,55	26,31	90,0
75,0	2,30	2,83	3,51	4,40	7,39	13,44	19,98	33,66	75,0
50,0	5,10	5,45	6,23	7,45	12,50	19,94	27,33	42,71	50,0
25,0	10,10	9,81	10,44	11,98	19,83	28,27	36,06	52,45	25,0
10,0	17,22	15,77	15,92	17,67	28,64	37,41	45,05	61,53	10,0
5,0	22,91	20,47	20,15	21,95	34,94	43,57	50,87	66,96	5,0
1,0	36,49	31,57	30,12	31,91	48,37	56,07	62,28	76,70	1,0
	1,5		2,5	4,0	6,5	10,0			
	Acceptance quality limit (tightened inspection) in percent nonconforming — code letter E								
	0,40	0,65	1,0	1,5	2,5	4,0	6,5	10,0	
	Acceptance quality limit (reduced inspection) in percent nonconforming — code letter G								

Figure 4 — Chart E — Operating characteristic curves for double sampling plans, normal inspection — Sample size code letter E, "*s*" method



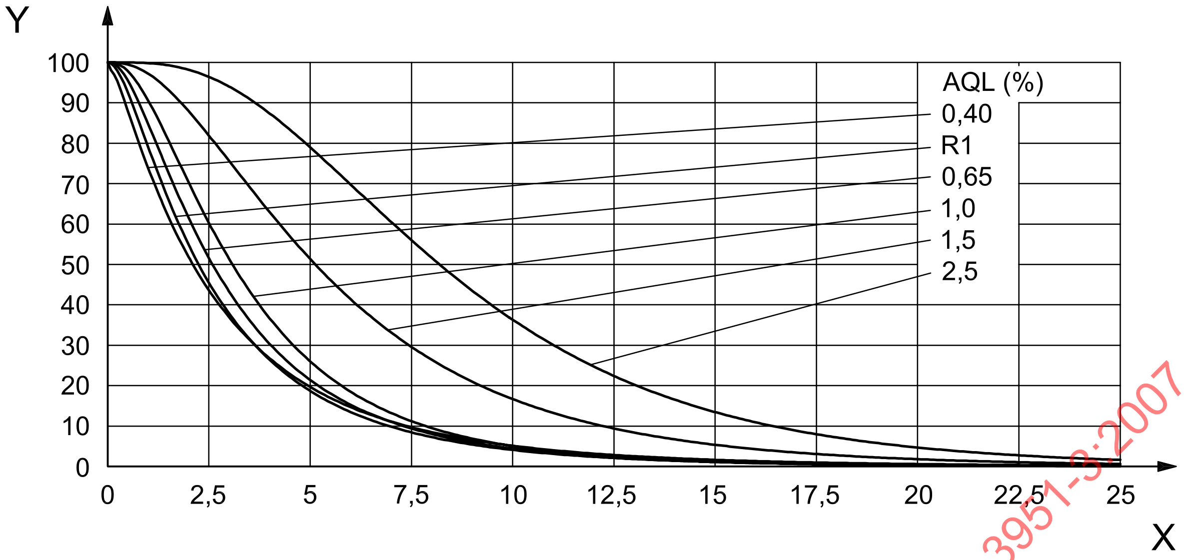
Key

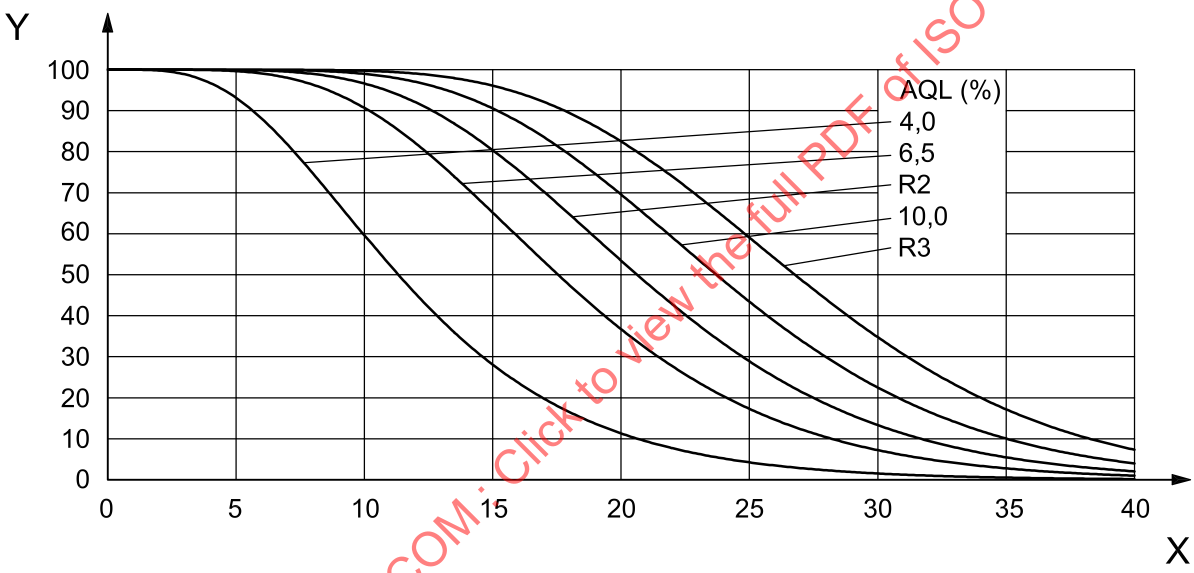
X process quality (in percent nonconforming)

Y percentage of lots expected to be accepted

P_a %	Acceptance quality limit (normal inspection) in percent nonconforming — code letter F									P_a %
	0,65	R1	1,0	1,5	2,5	4,0	6,5	10,0	R2	
99,0	0,106	0,248	0,388	0,538	0,927	2,66	4,84	9,92	13,14	99,0
95,0	0,402	0,616	0,849	1,13	1,93	4,52	7,48	14,00	17,84	95,0
90,0	0,692	0,945	1,25	1,61	2,76	5,86	9,25	16,57	20,70	90,0
75,0	1,54	1,84	2,26	2,81	4,77	8,73	12,86	21,50	26,06	75,0
50,0	3,35	3,60	4,12	4,91	8,23	13,04	17,94	27,97	32,83	50,0
25,0	6,58	6,60	7,11	8,18	13,40	18,76	24,28	35,49	40,45	25,0
10,0	11,28	10,89	11,19	12,48	19,94	25,32	31,20	43,18	48,02	10,0
5,0	15,15	14,39	14,45	15,84	24,84	29,98	35,94	48,18	52,83	5,0
1,0	25,02	23,10	22,48	23,99	35,99	40,14	45,92	58,11	62,22	1,0
	1,0		1,5	2,5	4,0	6,5	10,0			
	Acceptance quality limit (tightened inspection) in percent nonconforming — code letter F									
	0,25	0,40	0,65	1,0	1,5	2,5	4,0	6,5	10,0	
	Acceptance quality limit (reduced inspection) in percent nonconforming — code letter H									

Figure 5 — Chart F — Operating characteristic curves for double sampling plans, normal inspection — Sample size code letter F, "s" method





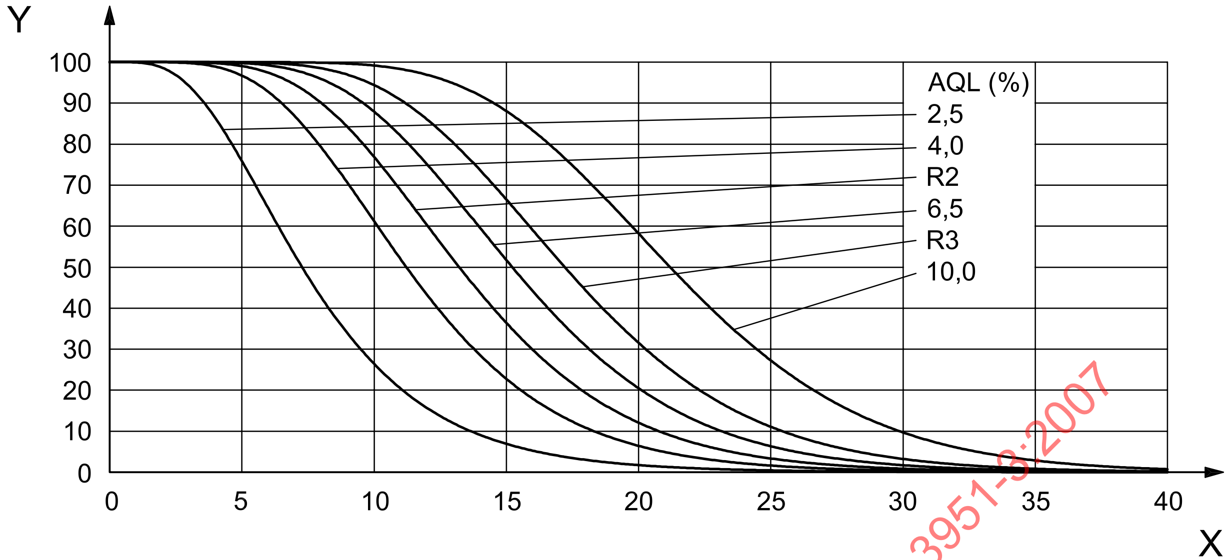
Key

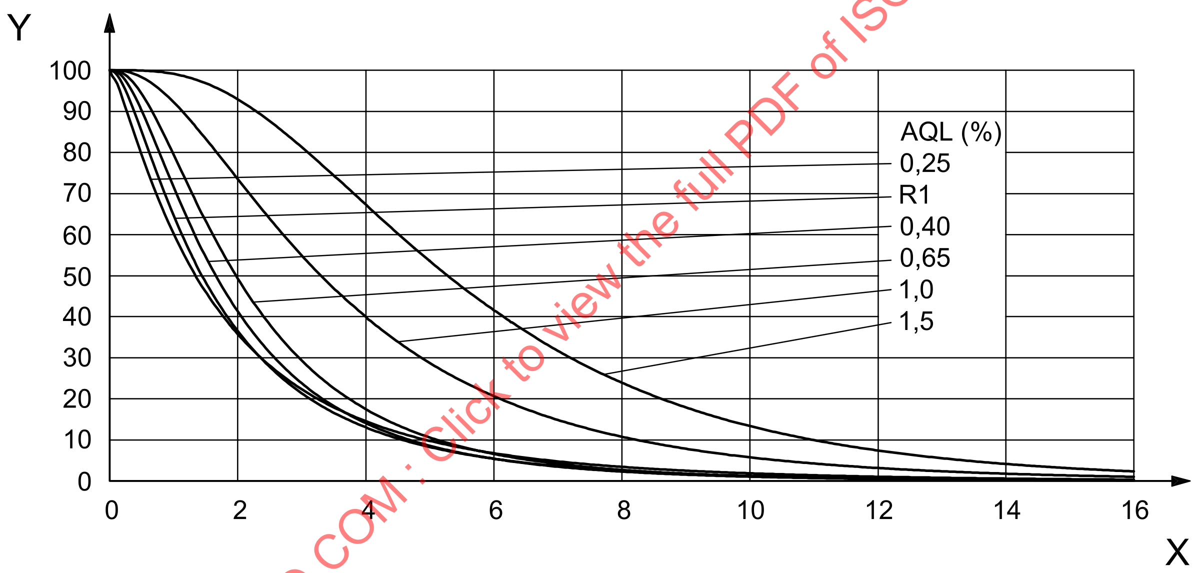
X process quality (in percent nonconforming)

Y percentage of lots expected to be accepted

P_a %	Acceptance quality limit (normal inspection) in percent nonconforming — code letter G											P_a %
	0,40	R1	0,65	1,0	1,5	2,5	4,0	6,5	R2	10,0	R3	
99,0	0,071	0,166	0,241	0,358	0,652	1,66	2,91	6,09	7,95	9,95	12,08	99,0
95,0	0,251	0,392	0,527	0,729	1,30	2,81	4,54	8,59	10,84	13,20	15,65	95,0
90,0	0,427	0,597	0,773	1,03	1,82	3,64	5,65	10,19	12,64	15,18	17,79	90,0
75,0	0,958	1,15	1,41	1,78	3,05	5,44	7,96	13,32	16,09	18,91	21,76	75,0
50,0	2,10	2,25	2,59	3,08	5,13	8,19	11,32	17,54	20,63	23,71	26,78	50,0
25,0	4,21	4,15	4,55	5,12	8,24	11,95	15,67	22,68	26,01	29,28	32,48	25,0
10,0	7,39	6,94	7,31	7,85	12,23	16,42	20,65	28,20	31,68	35,02	38,26	10,0
5,0	10,09	9,29	9,57	10,03	15,30	19,69	24,19	31,98	35,48	38,83	42,04	5,0
1,0	17,34	15,42	15,40	15,54	22,71	27,22	32,05	39,98	43,59	46,67	49,74	1,0
	0,65		1,0	1,5	2,5	4,0	6,5	10,0				
	Acceptance quality limit (tightened inspection) in percent nonconforming — code letter G											
	0,15	0,25	0,40	0,65	1,0	1,5	2,5	4,0	6,5		10,0	
	Acceptance quality limit (reduced inspection) in percent nonconforming — code letter J											

Figure 6 — Chart G — Operating characteristic curves for double sampling plans, normal inspection — Sample size code letter G, "*s*" method





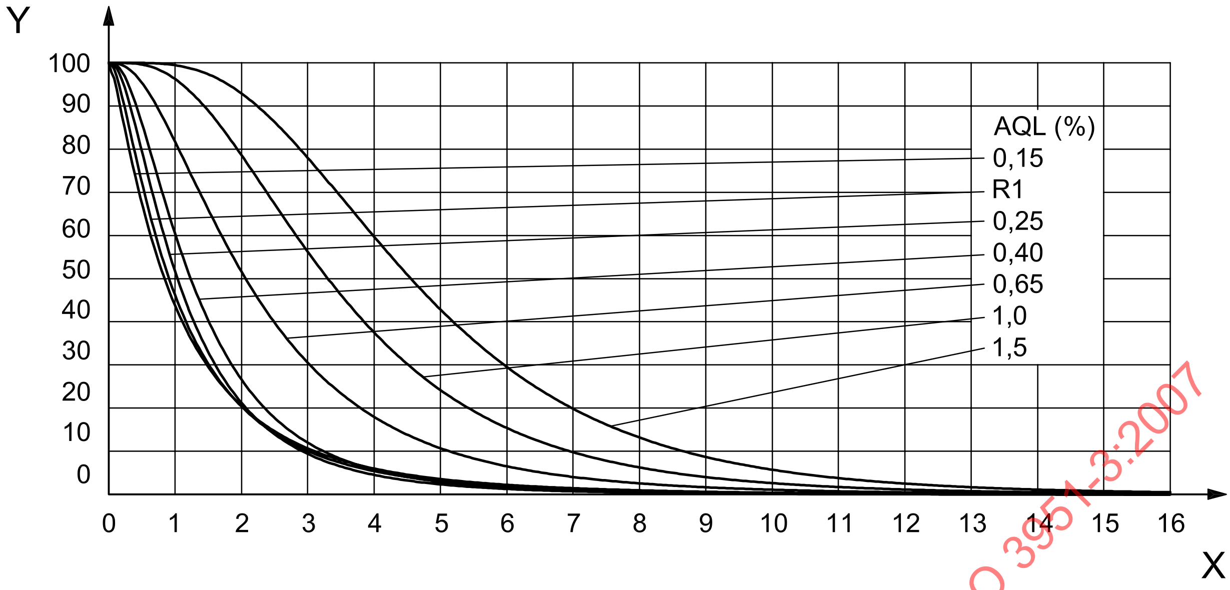
Key

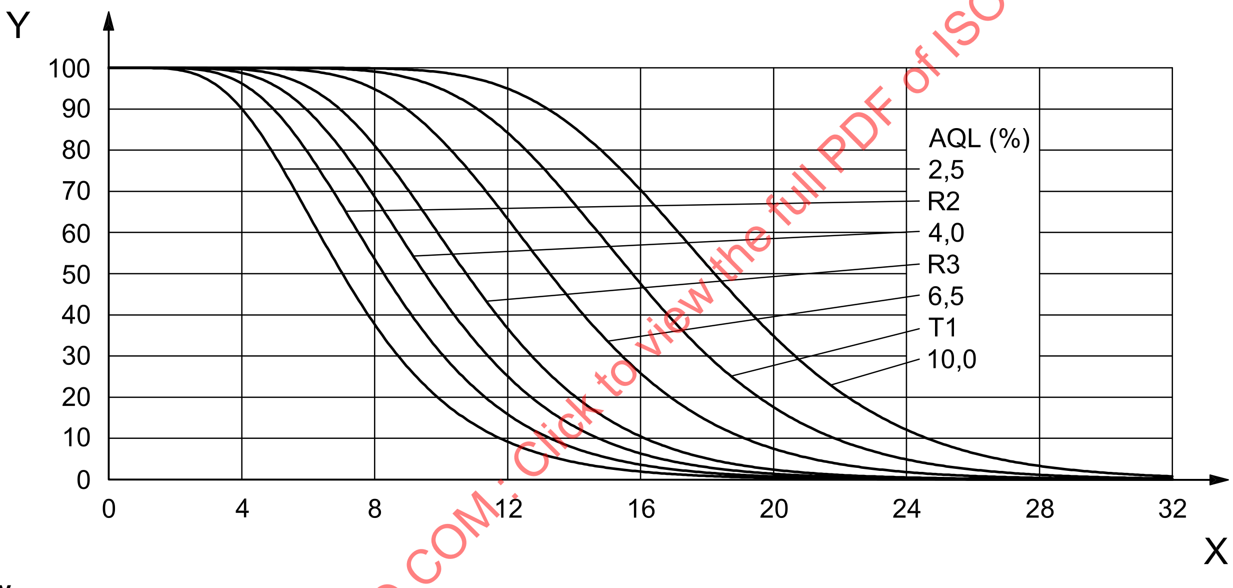
X process quality (in percent nonconforming)

Y percentage of lots expected to be accepted

P_a %	Acceptance quality limit (normal inspection) in percent nonconforming — code letter H												P_a %
	0,25	R1	0,40	0,65	1,0	1,5	2,5	4,0	R2	6,5	R3	10,0	
99,0	0,0467	0,108	0,163	0,232	0,404	1,04	1,84	3,92	5,04	6,25	7,52	10,24	99,0
95,0	0,157	0,252	0,348	0,469	0,809	1,76	2,87	5,50	6,87	8,31	9,80	12,93	95,0
90,0	0,267	0,382	0,505	0,662	1,14	2,29	3,58	6,51	8,02	9,58	11,19	14,52	90,0
75,0	0,603	0,737	0,908	1,14	1,93	3,46	5,08	8,50	10,24	12,02	13,81	17,47	75,0
50,0	1,34	1,45	1,66	1,98	3,30	5,28	7,28	11,22	13,22	15,23	17,22	21,20	50,0
25,0	2,75	2,70	2,91	3,30	5,42	7,84	10,22	14,60	16,84	19,05	21,22	25,47	25,0
10,0	4,94	4,57	4,68	5,12	8,23	10,98	13,66	18,32	20,77	23,14	25,44	29,87	10,0
5,0	6,86	6,19	6,17	6,59	10,46	13,35	16,17	20,93	23,48	25,93	28,29	32,79	5,0
1,0	12,11	10,55	10,11	10,42	16,04	18,98	21,97	26,68	29,39	31,94	34,36	38,91	1,0
	0,40		0,65	1,0	1,5	2,5	4,0	6,5			10,0		
	Acceptance quality limit (tightened inspection) in percent nonconforming — code letter H												
	0,10	0,15	0,25	0,40	0,65	1,0	1,5	2,5	4,0		6,5	10,0	
	Acceptance quality limit (reduced inspection) in percent nonconforming — code letter K												

Figure 7 — Chart H — Operating characteristic curves for double sampling plans, normal inspection — Sample size code letter H, "s" method





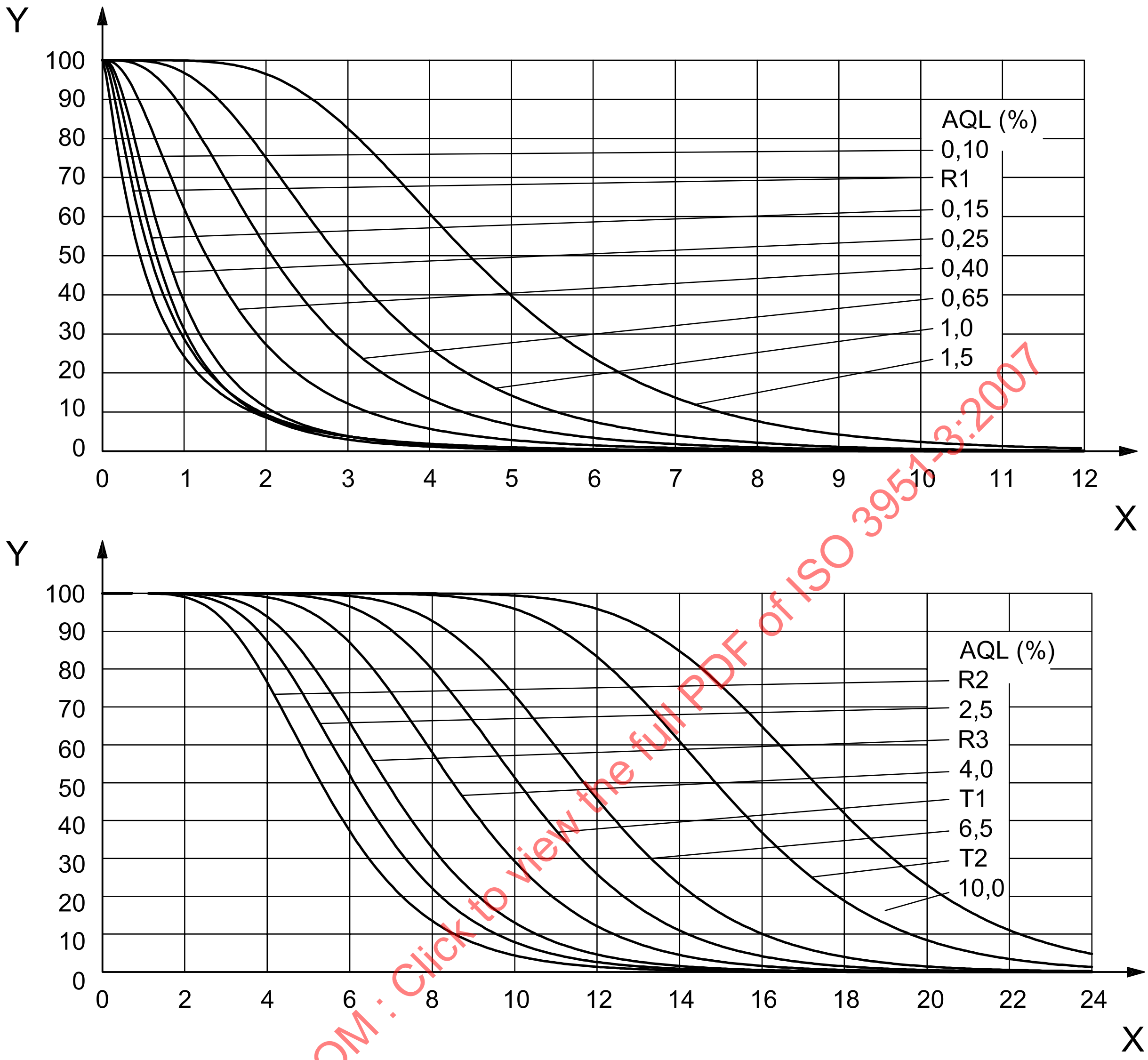
Key

X process quality (in percent nonconforming)

Y percentage of lots expected to be accepted

P_a %	Acceptance quality limit (normal inspection) in percent nonconforming — code letter J														P_a %
	0,15	R1	0,25	0,40	0,65	1,0	1,5	2,5	R2	4,0	R3	6,5	T1	10,0	
99,0	0,0292	0,0654	0,107	0,148	0,264	0,656	1,16	2,40	3,11	3,87	4,68	6,29	8,07	9,89	99,0
95,0	0,101	0,154	0,224	0,296	0,519	1,11	1,80	3,38	4,25	5,15	6,09	7,97	9,97	12,00	95,0
90,0	0,171	0,235	0,323	0,417	0,723	1,44	2,24	4,02	4,97	5,94	6,96	8,97	11,09	13,23	90,0
75,0	0,381	0,458	0,574	0,712	1,21	2,16	3,17	5,28	6,38	7,48	8,60	10,86	13,15	15,46	75,0
50,0	0,843	0,912	1,04	1,24	2,06	3,30	4,55	7,04	8,29	9,53	10,77	13,29	15,75	18,25	50,0
25,0	1,72	1,74	1,81	2,08	3,37	4,93	6,42	9,27	10,67	12,02	13,36	16,13	18,74	21,40	25,0
10,0	3,10	3,01	2,92	3,24	5,13	6,95	8,66	11,79	13,30	14,75	16,14	19,14	21,85	24,64	10,0
5,0	4,33	4,13	3,85	4,19	6,55	8,50	10,32	13,59	15,16	16,65	18,07	21,19	23,94	26,79	5,0
1,0	7,86	7,27	6,39	6,74	10,18	12,29	14,25	17,68	19,32	20,86	22,28	25,61	28,39	31,33	1,0
	0,25		0,40	0,65	1,0	1,5	2,5	4,0			6,5		10,0		
	Acceptance quality limit (tightened inspection) in percent nonconforming — code letter J														
	0,065	0,10	0,15	0,25	0,40	0,65	1,0	1,5	2,5		4,0	6,5			
	Acceptance quality limit (reduced inspection) in percent nonconforming — code letter L														

Figure 8 — Chart J — Operating characteristic curves for double sampling plans, normal inspection — Sample size code letter J, "s" method



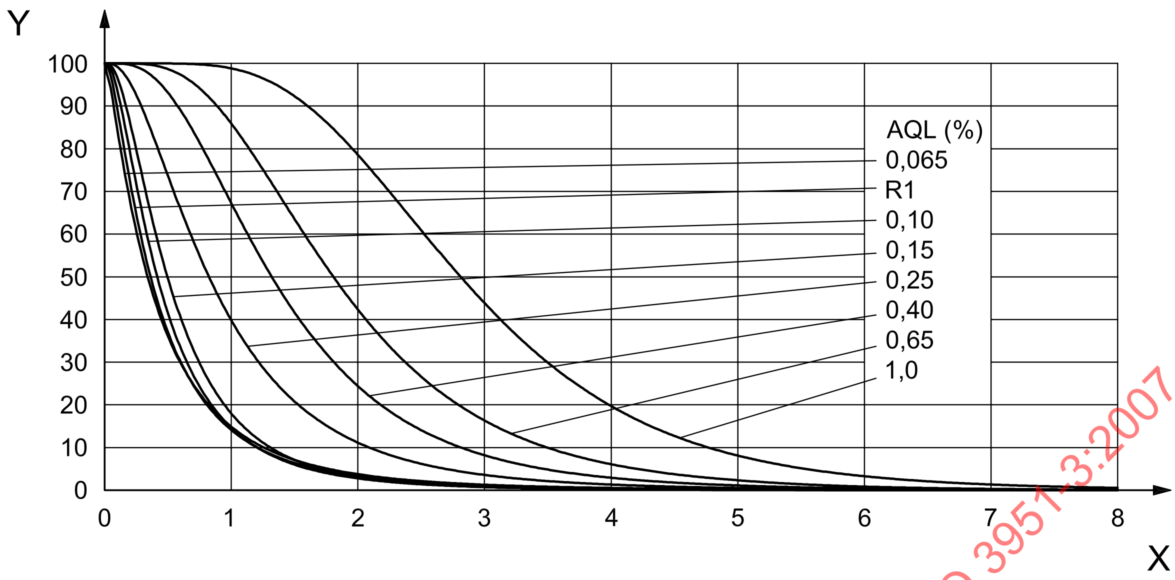
Key

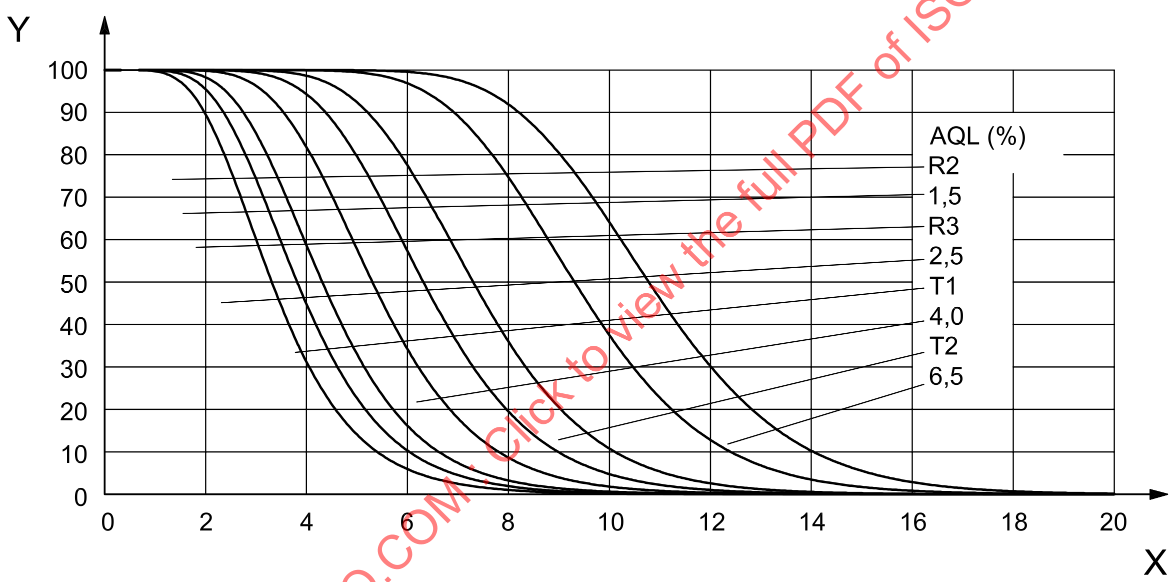
X process quality (in percent nonconforming)

Y percentage of lots expected to be accepted

P_a %	Acceptance quality limit (normal inspection) in percent nonconforming — code letter K															P_a %
	0,10	R1	0,15	0,25	0,40	0,65	1,0	1,5	R2	2,5	R3	4,0	T1	6,5	T2	10,0	
99,0	0,0203	0,0434	0,0698	0,0950	0,171	0,428	0,746	1,55	1,99	2,47	2,95	3,99	5,10	6,25	8,64	10,50	99,0
95,0	0,0651	0,100	0,145	0,189	0,334	0,715	1,15	2,18	2,71	3,28	3,86	5,06	6,32	7,60	10,24	12,26	95,0
90,0	0,110	0,152	0,208	0,266	0,464	0,924	1,43	2,58	3,17	3,79	4,42	5,70	7,04	8,40	11,16	13,27	90,0
75,0	0,243	0,294	0,368	0,455	0,777	1,35	2,03	3,38	4,07	4,78	5,49	6,92	8,38	9,85	12,83	15,08	75,0
50,0	0,539	0,584	0,665	0,794	1,32	2,11	2,92	4,50	5,31	6,11	6,91	8,50	10,09	11,69	14,89	17,29	50,0
25,0	1,11	1,11	1,16	1,34	2,17	3,15	4,13	5,93	6,87	7,74	8,64	10,38	12,09	13,81	17,22	19,76	25,0
10,0	2,01	1,94	1,88	2,11	3,32	4,46	5,59	7,57	8,62	9,56	10,54	12,40	14,20	16,02	19,60	22,26	10,0
5,0	2,82	2,68	2,50	2,75	4,26	5,47	6,69	8,74	9,87	10,84	11,86	13,80	15,64	17,52	21,19	23,92	5,0
1,0	5,11	4,76	4,19	4,46	6,72	8,00	9,32	11,47	12,72	13,72	14,83	16,87	18,76	20,75	24,56	27,39	1,0
	0,15		0,25	0,40	0,65	1,0	1,5	2,5			4,0		6,5		10,0		
	Acceptance quality limit (tightened inspection) in percent nonconforming — code letter K																
	0,040	0,065	0,10	0,15	0,25	0,40	0,65	1,0	1,5		2,5	4,0					
	Acceptance quality limit (reduced inspection) in percent nonconforming — code letter M																

Figure 9 — Chart K — Operating characteristic curves for double sampling plans, normal inspection — Sample size code letter K, "s" method





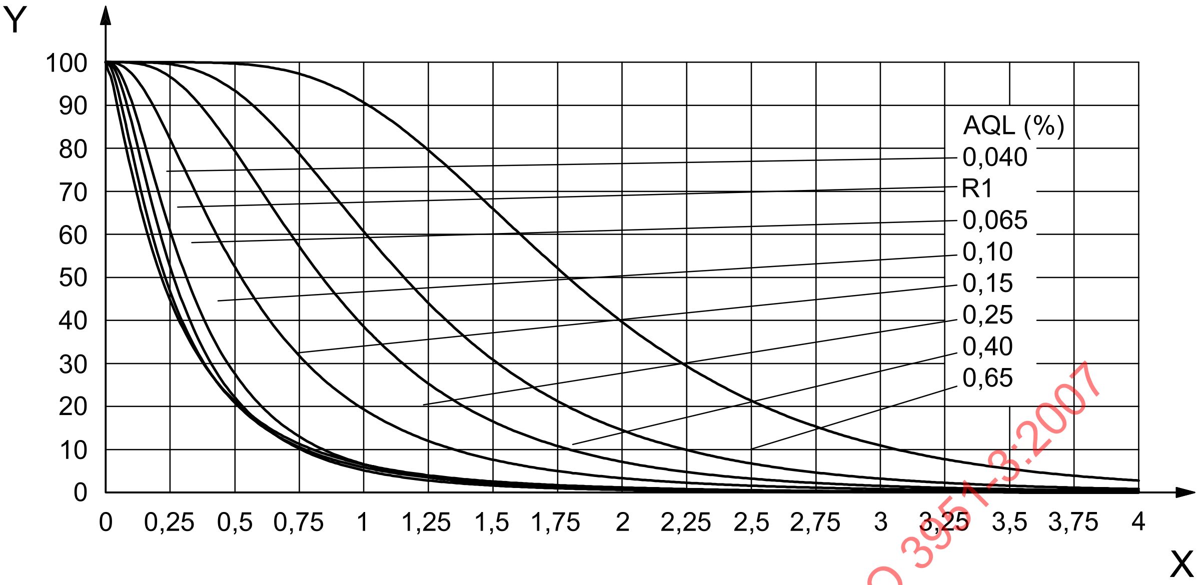
Key

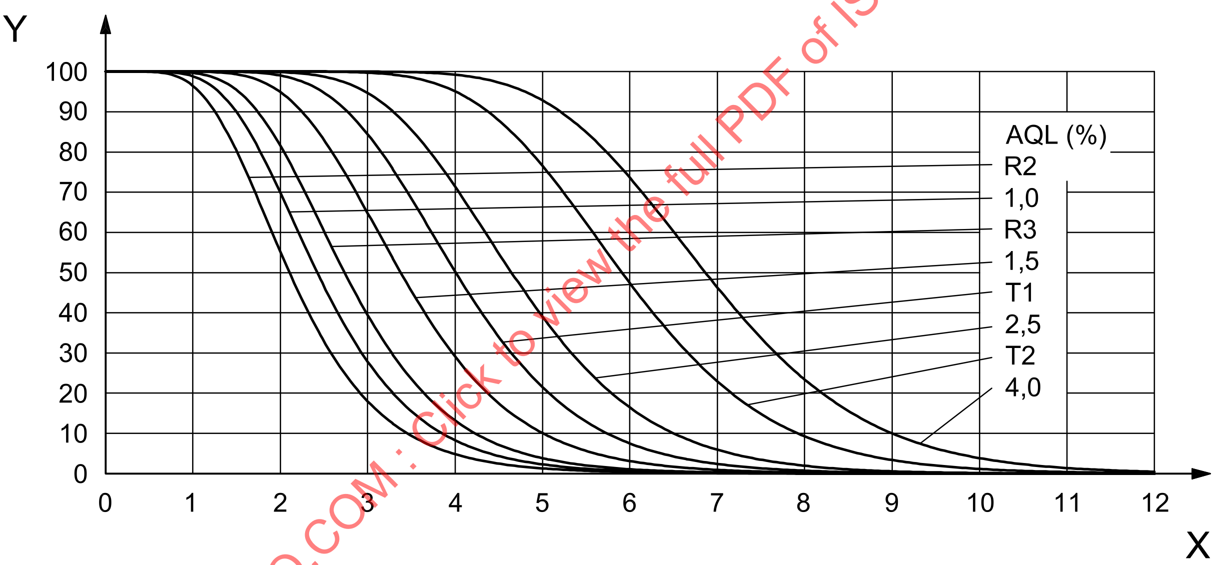
X process quality (in percent nonconforming)

Y percentage of lots expected to be accepted

P_a %	Acceptance quality limit (normal inspection) in percent nonconforming — code letter L																P_a %
	0,065	R1	0,10	0,15	0,25	0,40	0,65	1,0	R2	1,5	R3	2,5	T1	4,0	T2	6,5	
99,0	0,0117	0,0280	0,0431	0,0610	0,108	0,269	0,471	0,963	1,25	1,53	1,85	2,49	3,17	3,86	5,34	6,49	99,0
95,0	0,0418	0,0642	0,0896	0,121	0,209	0,448	0,723	1,35	1,70	2,04	2,41	3,16	3,92	4,71	6,35	7,60	95,0
90,0	0,0704	0,0966	0,129	0,169	0,290	0,578	0,898	1,60	1,98	2,36	2,75	3,56	4,38	5,21	6,93	8,24	90,0
75,0	0,154	0,185	0,229	0,287	0,485	0,866	1,27	2,11	2,54	2,98	3,42	4,32	5,22	6,14	7,99	9,39	75,0
50,0	0,339	0,364	0,416	0,496	0,825	1,32	1,82	2,82	3,32	3,82	4,32	5,32	6,32	7,32	9,32	10,81	50,0
25,0	0,692	0,691	0,735	0,835	1,36	1,98	2,58	3,74	4,29	4,87	5,41	6,51	7,60	8,70	10,83	12,42	25,0
10,0	1,25	1,21	1,20	1,31	2,09	2,82	3,51	4,81	5,40	6,04	6,62	7,81	8,98	10,15	12,41	14,07	10,0
5,0	1,76	1,67	1,61	1,71	2,69	3,47	4,22	5,59	6,20	6,88	7,48	8,72	9,93	11,15	13,47	15,17	5,0
1,0	3,26	3,03	2,76	2,80	4,30	5,12	5,92	7,42	8,04	8,79	9,42	10,74	12,03	13,33	15,75	17,52	1,0
	0,10		0,15	0,25	0,40	0,65	1,0	1,5			2,5		4,0		6,5		
	Acceptance quality limit (tightened inspection) in percent nonconforming — code letter L																
	0,025	0,040	0,065	0,10	0,15	0,25	0,40	0,65	1,0		1,5	2,5					
	Acceptance quality limit (reduced inspection) in percent nonconforming — code letter N																

Figure 10 — Chart L — Operating characteristic curves for double sampling plans, normal inspection — Sample size code letter L, "*s*" method





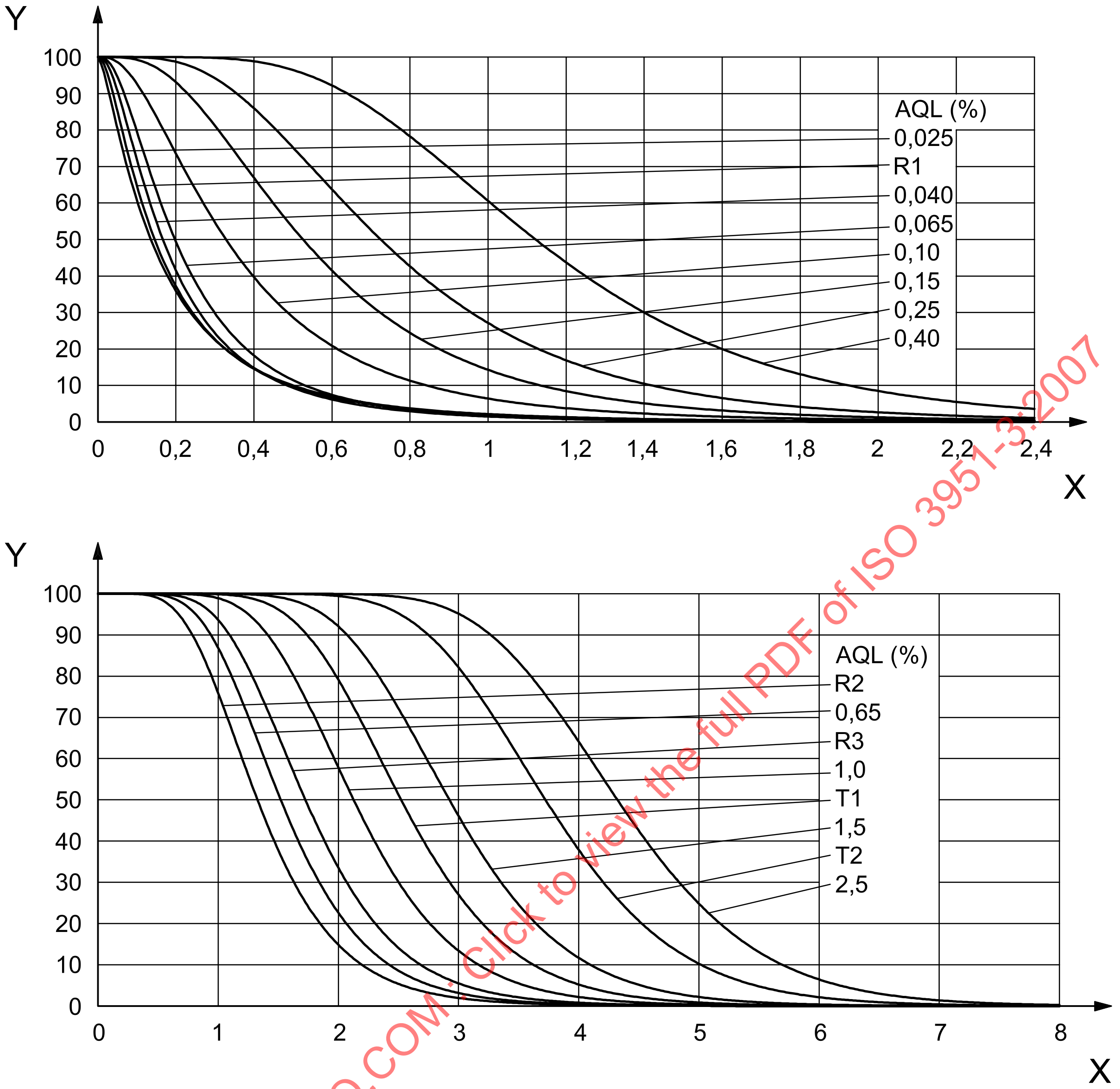
Key

X process quality (in percent nonconforming)

Y percentage of lots expected to be accepted

P_a %	Acceptance quality limit (normal inspection) in percent nonconforming — code letter M																P_a %
	0,040	R1	0,065	0,10	0,15	0,25	0,40	0,65	R2	1,0	R3	1,5	T1	2,5	T2	4,0	
99,0	0,00820	0,0182	0,0276	0,0386	0,0683	0,172	0,300	0,615	0,791	0,976	1,17	1,58	2,00	2,45	3,38	4,09	99,0
95,0	0,0269	0,0410	0,0572	0,0759	0,133	0,286	0,460	0,860	1,07	1,30	1,53	2,00	2,49	2,99	4,01	4,80	95,0
90,0	0,0448	0,0616	0,0820	0,106	0,184	0,368	0,570	1,02	1,26	1,50	1,75	2,25	2,77	3,30	4,39	5,21	90,0
75,0	0,0981	0,117	0,145	0,181	0,307	0,550	0,804	1,34	1,61	1,89	2,17	2,74	3,31	3,89	5,06	5,94	75,0
50,0	0,215	0,231	0,264	0,315	0,525	0,839	1,16	1,79	2,11	2,43	2,74	3,38	4,01	4,65	5,92	6,86	50,0
25,0	0,440	0,439	0,468	0,534	0,870	1,26	1,64	2,38	2,74	3,10	3,45	4,15	4,85	5,53	6,90	7,91	25,0
10,0	0,799	0,770	0,770	0,846	1,35	1,80	2,24	3,07	3,46	3,86	4,24	4,99	5,74	6,48	7,93	9,00	10,0
5,0	1,13	1,07	1,03	1,11	1,75	2,22	2,70	3,57	3,98	4,40	4,80	5,58	6,36	7,12	8,63	9,73	5,0
1,0	2,10	1,97	1,79	1,85	2,83	3,30	3,83	4,76	5,20	5,65	6,08	6,91	7,75	8,56	10,14	11,31	1,0
	0,065		0,10	0,15	0,25	0,40	0,65	1,0			1,5		2,5		4,0		
	Acceptance quality limit (tightened inspection) in percent nonconforming — code letter M																
	0,015	0,025	0,040	0,065	0,10	0,15	0,25	0,40	0,65		1,0	1,5					
	Acceptance quality limit (reduced inspection) in percent nonconforming — code letter P																

Figure 11 — Chart M — Operating characteristic curves for double sampling plans, normal inspection — Sample size code letter M, "*s*" method



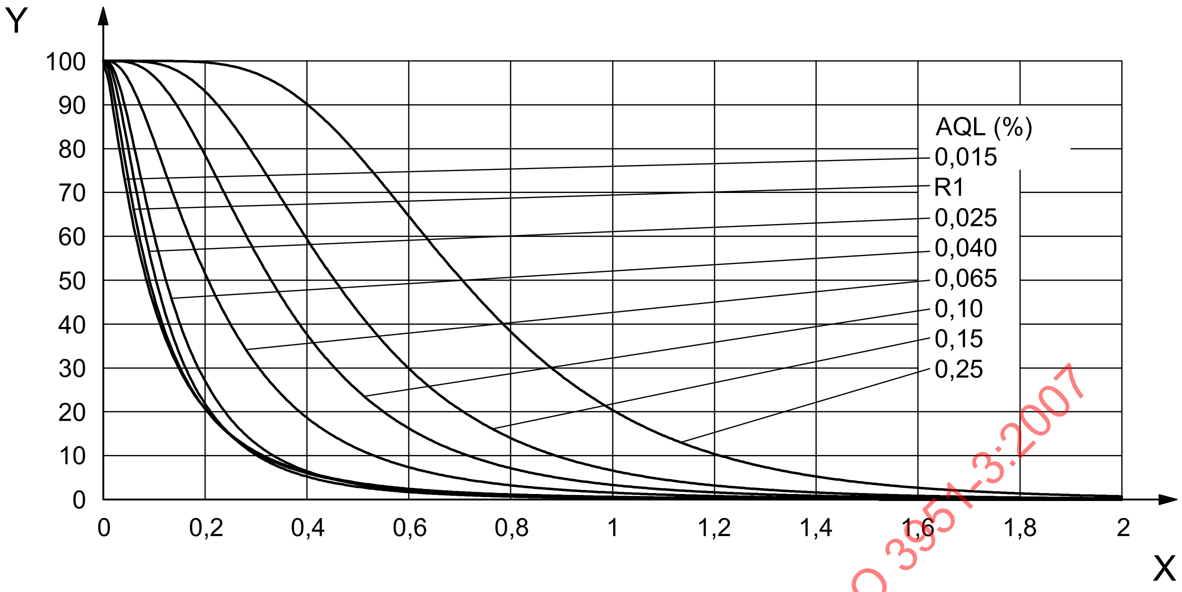
Key

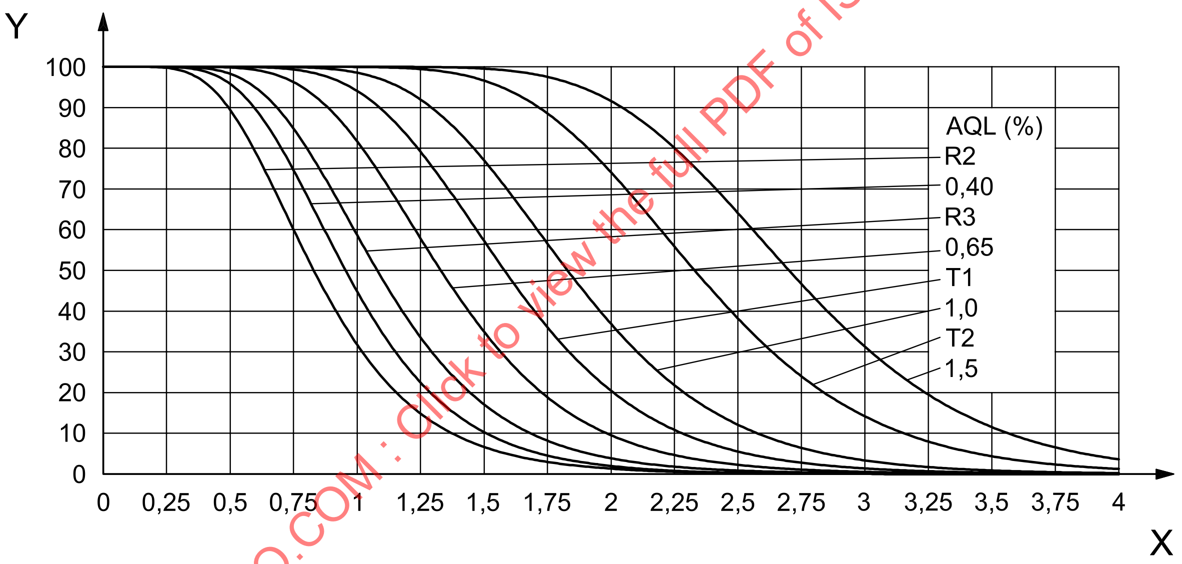
X process quality (in percent nonconforming)

Y percentage of lots expected to be accepted

P_a %	Acceptance quality limit (normal inspection) in percent nonconforming — code letter N															P_a %
	0,025	R1	0,040	0,065	0,10	0,15	0,25	0,40	R2	0,65	R3	1,0	T1	1,5	T2	2,5	
99,0	0,00544	0,0115	0,0178	0,0248	0,0442	0,109	0,191	0,388	0,499	0,615	0,737	0,993	1,26	1,54	2,12	2,57	99,0
95,0	0,0168	0,0258	0,0364	0,0485	0,0847	0,180	0,291	0,542	0,677	0,816	0,960	1,26	1,56	1,88	2,52	3,02	95,0
90,0	0,0280	0,0387	0,0520	0,0676	0,117	0,231	0,360	0,642	0,790	0,942	1,10	1,42	1,75	2,08	2,76	3,27	90,0
75,0	0,0613	0,0738	0,0917	0,114	0,194	0,346	0,507	0,843	1,02	1,19	1,37	1,72	2,08	2,45	3,19	3,74	75,0
50,0	0,135	0,146	0,166	0,199	0,330	0,529	0,729	1,13	1,33	1,53	1,73	2,13	2,53	2,93	3,73	4,32	50,0
25,0	0,277	0,279	0,294	0,336	0,546	0,795	1,04	1,50	1,73	1,96	2,18	2,62	3,06	3,49	4,36	5,00	25,0
10,0	0,509	0,493	0,485	0,532	0,846	1,14	1,41	1,94	2,19	2,44	2,68	3,16	3,63	4,10	5,02	5,70	10,0
5,0	0,721	0,691	0,652	0,699	1,10	1,41	1,71	2,26	2,53	2,79	3,04	3,54	4,03	4,52	5,47	6,17	5,0
1,0	1,33	1,26	1,13	1,16	1,78	2,11	2,42	3,04	3,32	3,60	3,87	4,41	4,92	5,45	6,47	7,21	1,0
	0,040		0,065	0,10	0,15	0,25	0,40	0,65			1,0		1,5		2,5		
	Acceptance quality limit (tightened inspection) in percent nonconforming — code letter N																
	0,010	0,015	0,025	0,040	0,065	0,10	0,15	0,25	0,40		0,65	1,0					
	Acceptance quality limit (reduced inspection) in percent nonconforming — code letter Q																

Figure 12 — Chart N — Operating characteristic curves for double sampling plans, normal inspection — Sample size code letter N, "s" method





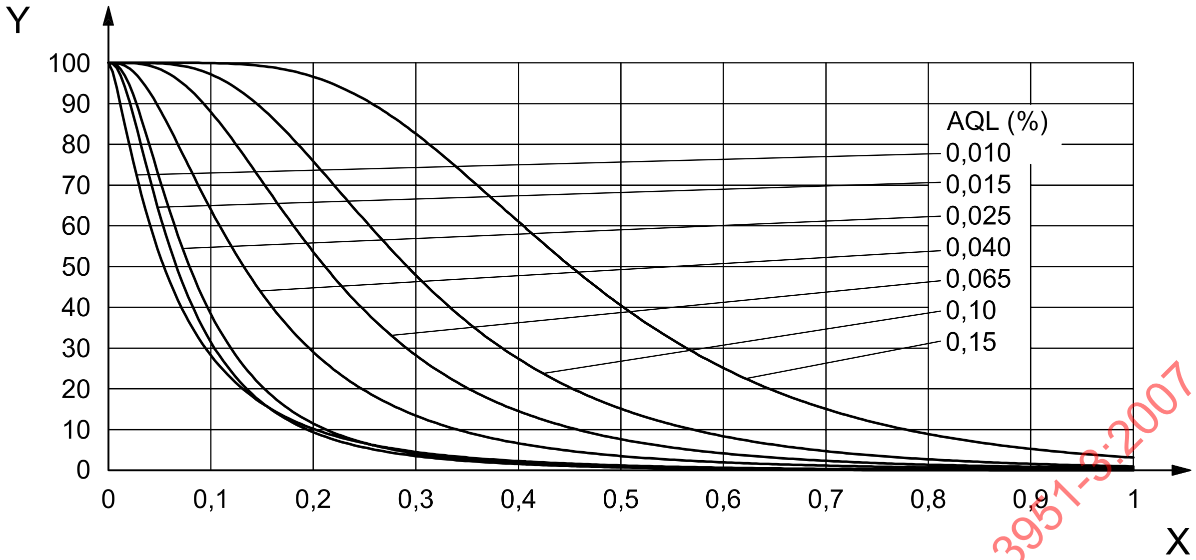
Key

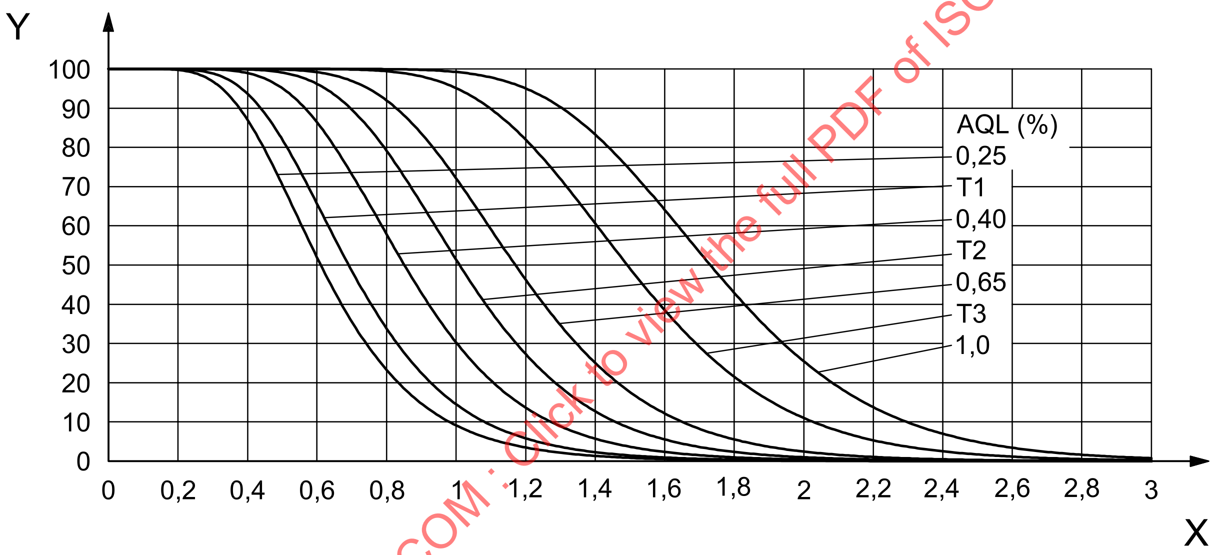
X process quality (in percent nonconforming)

Y percentage of lots expected to be accepted

P_a %	Acceptance quality limit (normal inspection) in percent nonconforming — code letter P															P_a %
	0,015	R1	0,025	0,040	0,065	0,10	0,15	0,25	R2	0,40	R3	0,65	T1	1,0	T2	1,5	
99,0	0,00329	0,00729	0,0113	0,0158	0,0277	0,0681	0,120	0,243	0,312	0,387	0,461	0,622	0,787	0,960	1,32	1,60	99,0
95,0	0,0107	0,0162	0,0230	0,0306	0,0530	0,112	0,182	0,339	0,423	0,512	0,600	0,786	0,975	1,17	1,57	1,88	95,0
90,0	0,0176	0,0243	0,0327	0,0425	0,0730	0,145	0,225	0,401	0,494	0,590	0,686	0,887	1,09	1,30	1,72	2,04	90,0
75,0	0,0385	0,0462	0,0574	0,0716	0,121	0,216	0,317	0,527	0,634	0,744	0,854	1,08	1,30	1,53	1,99	2,34	75,0
50,0	0,0843	0,0911	0,104	0,124	0,206	0,331	0,455	0,706	0,831	0,955	1,08	1,33	1,58	1,83	2,33	2,70	50,0
25,0	0,173	0,175	0,183	0,209	0,342	0,499	0,647	0,940	1,08	1,22	1,36	1,64	1,92	2,19	2,73	3,13	25,0
10,0	0,318	0,310	0,302	0,331	0,532	0,718	0,885	1,22	1,37	1,52	1,68	1,98	2,28	2,58	3,15	3,57	10,0
5,0	0,452	0,436	0,407	0,436	0,692	0,893	1,07	1,42	1,59	1,74	1,91	2,22	2,54	2,84	3,44	3,88	5,0
1,0	0,857	0,822	0,712	0,729	1,12	1,35	1,53	1,91	2,09	2,25	2,44	2,77	3,11	3,44	4,08	4,54	1,0
	0,025		0,040	0,065	0,10	0,15	0,25	0,40			0,65		1,0		1,5		
	Acceptance quality limit (tightened inspection) in percent nonconforming — code letter P																
		0,010	0,015	0,025	0,040	0,065	0,10	0,15	0,25		0,40	0,65					
	Acceptance quality limit (reduced inspection) in percent nonconforming — code letter R																

Figure 13 — Chart P — Operating characteristic curves for double sampling plans, normal inspection — Sample size code letter P, "s" method





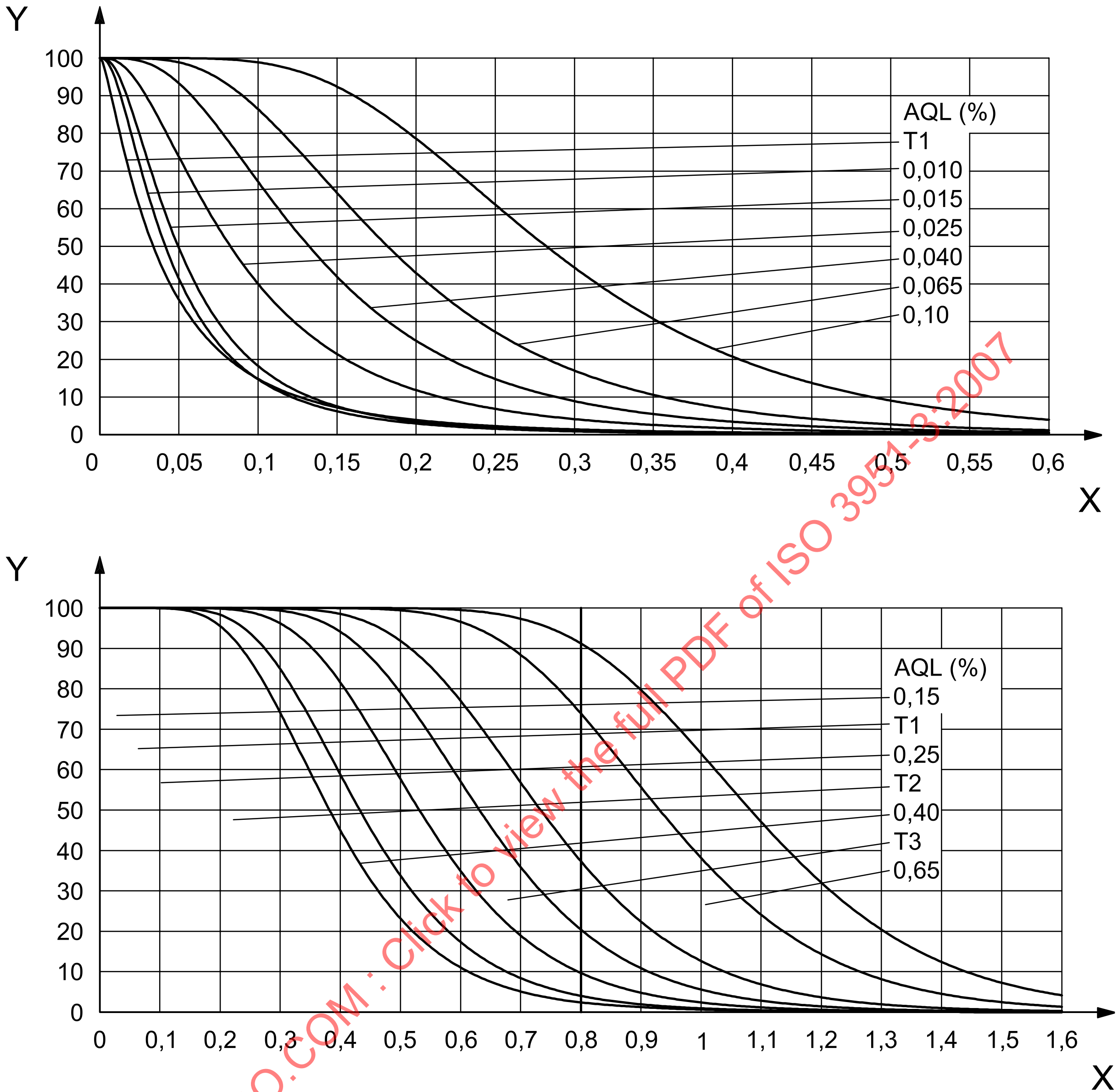
Key

X process quality (in percent nonconforming)

Y percentage of lots expected to be accepted

P_a %	Acceptance quality limit (normal inspection) in percent nonconforming — code letter Q														P_a %
	0,010	0,015	0,025	0,040	0,065	0,10	0,15	0,25	T1	0,40	T2	0,65	T3	1,0	
99,0	0,00230	0,00734	0,0102	0,0180	0,0441	0,0770	0,156	0,247	0,296	0,398	0,506	0,615	0,844	1,03	99,0
95,0	0,00694	0,0148	0,0196	0,0341	0,0725	0,117	0,217	0,327	0,384	0,503	0,625	0,749	1,00	1,20	95,0
90,0	0,0115	0,0210	0,0273	0,0470	0,0930	0,144	0,257	0,377	0,439	0,567	0,697	0,829	1,10	1,31	90,0
75,0	0,0249	0,0368	0,0458	0,0778	0,138	0,203	0,337	0,476	0,546	0,689	0,833	0,978	1,27	1,50	75,0
50,0	0,0542	0,0665	0,0792	0,132	0,211	0,292	0,451	0,612	0,691	0,851	1,01	1,17	1,49	1,73	50,0
25,0	0,111	0,117	0,134	0,219	0,318	0,415	0,601	0,785	0,873	1,05	1,22	1,40	1,75	2,01	25,0
10,0	0,202	0,194	0,212	0,340	0,457	0,569	0,778	0,982	1,08	1,27	1,46	1,65	2,02	2,29	10,0
5,0	0,286	0,261	0,279	0,443	0,568	0,689	0,909	1,13	1,23	1,42	1,62	1,82	2,21	2,49	5,0
1,0	0,526	0,455	0,465	0,727	0,858	0,991	1,23	1,46	1,57	1,78	1,99	2,21	2,63	2,92	1,0
	0,015	0,025	0,040	0,065	0,10	0,15	0,25		0,40		0,65		1,0		
	Acceptance quality limit (tightened inspection) in percent nonconforming — code letter Q														

Figure 14 — Chart Q — Operating characteristic curves for double sampling plans, normal inspection — Sample size code letter Q, "*s*" method



Key

X process quality (in percent nonconforming)

Y percentage of lots expected to be accepted

P_a %	Acceptance quality limit (normal inspection) in percent nonconforming — code letter R													P_a %
	T1	0,010	0,015	0,025	0,040	0,065	0,10	0,15	T1	0,25	T2	0,40	T3	0,65	
99,0	0,00129	0,00461	0,00636	0,0112	0,0276	0,0483	0,0978	0,155	0,185	0,249	0,315	0,385	0,528	0,641	99,0
95,0	0,00436	0,00931	0,0123	0,0213	0,0452	0,0732	0,136	0,204	0,240	0,314	0,390	0,469	0,628	0,752	95,0
90,0	0,00722	0,0132	0,0171	0,0293	0,0580	0,0903	0,161	0,236	0,274	0,354	0,435	0,518	0,687	0,816	90,0
75,0	0,0156	0,0230	0,0287	0,0485	0,0864	0,127	0,211	0,297	0,341	0,430	0,520	0,612	0,795	0,934	75,0
50,0	0,0338	0,0416	0,0496	0,0825	0,132	0,182	0,282	0,382	0,432	0,532	0,632	0,733	0,932	1,08	50,0
25,0	0,0690	0,0734	0,0838	0,137	0,200	0,259	0,377	0,489	0,547	0,657	0,768	0,877	1,09	1,25	25,0
10,0	0,126	0,121	0,133	0,215	0,288	0,356	0,488	0,613	0,677	0,795	0,916	1,03	1,26	1,43	10,0
5,0	0,179	0,164	0,175	0,280	0,359	0,431	0,571	0,703	0,771	0,894	1,02	1,14	1,38	1,56	5,0
1,0	0,339	0,289	0,296	0,461	0,546	0,622	0,774	0,913	0,991	1,12	1,26	1,39	1,64	1,83	1,0
	0,01	0,015	0,025	0,040	0,065	0,10	0,15		0,25		0,40		0,65		
	Acceptance quality limit (tightened inspection) in percent nonconforming — code letter R														

Figure 15 — Chart R — Operating characteristic curves for double sampling plans, normal inspection — Sample size code letter R, "*s*" method

Annex A
(informative)

Standard multivariate "s" method procedures for double sampling with independent quality characteristics

A.1 Procedure for a single class of nonconformity

The general method for dealing with a single class of m independent quality characteristics when the process standard deviation of none of the characteristics is known is as follows:

a) Enter Table 9 with the lot size and inspection level in order to determine the sample size code letter.

b) Depending on the inspection severity, enter Table 26, 27 or 28 with the sample size code letter and the AQL applying to the class in order to determine the double sample size n and the acceptability constants p_a^*, p_r^* and p_c^*.

c) Select a sample of size n at random from the lot, and measure the m quality characteristics on each item of the sample.

d) Determine the estimated process fraction nonconforming in the first sample for each of the m characteristics in accordance with the procedures in Clause 16.

Denoting the estimated process fraction nonconforming for the ith quality characteristic by $\hat{p}_{1,i}$, the estimated process fraction nonconforming from the first sample for the whole class is calculated as

$$\hat{p}_1 = 1-(1-\hat{p}_{1,1})(1-\hat{p}_{1,2})\ldots(1-\hat{p}_{1,m}),$$

i.e. one minus the product of the estimated process fractions *conforming*.

NOTE If $\hat{p}_{1,1}$, $\hat{p}_{1,2}$, ..., $\hat{p}_{1,m}$ are all small, then $\hat{p}_1$ is approximately equal to the sum of the individual estimates, i.e. $\hat{p}_1 \cong \hat{p}_{1,1} + \hat{p}_{1,2} + \ldots + \hat{p}_{1,m}$.

The lot is accepted if $\hat{p}_1 \leqslant p_a^*$ or non-accepted if $\hat{p}_1 \geqslant p_r^*$. If $p_a^* < \hat{p}_1 < p_r^*$, a second random sample of size n is selected and measurements made of all m quality characteristics on all items in the sample. Then, for each characteristic, the means and standard deviations of both samples are combined, and a combined estimate of the process fraction nonconforming of the characteristic is calculated. Denoting these combined estimates by $\hat{p}_{c,1}$, $\hat{p}_{c,2}$, ..., $\hat{p}_{c,m}$, the estimated process fraction nonconforming from the combined samples for the whole class is given by

$$\hat{p}_c = 1-(1-\hat{p}_{c,1})(1-\hat{p}_{c,2}) \ldots (1-\hat{p}_{c,m}).$$

The lot is then acceptable if $\hat{p}_c \leqslant p_c^*$ and non-acceptable if $\hat{p}_c > p_c^*$.

A.2 Procedure for more than one class of nonconformity

The procedure becomes more complicated if there are two or more classes of nonconformity. If there are several classes, say class A, class B, etc., then some further notation is helpful. Suppose that the estimated process fractions nonconforming for the classes are denoted by $\hat{p}_{A,1}$, $\hat{p}_{B,1}$, ... for the first set of samples and, when required, denoted by $\hat{p}_{A,c}$, $\hat{p}_{B,c}$, ... for the combined samples. Suppose also that the sample sizes and acceptability constants are denoted by n_A, $p_{A,a}^*$, $p_{A,r}^*$ and $p_{A,c}^*$ for class A, n_B, $p_{B,a}^*$, $p_{B,r}^*$ and $p_{B,c}^*$ for class B, etc. The lot is acceptable after the first set of samples if $\hat{p}_{A,1} \leqslant p_{A,a}^*$ and $\hat{p}_{B,1} \leqslant p_{B,a}^*$ and ... but not acceptable if $\hat{p}_{A,1} \geqslant p^*_{A,r}$ or $\hat{p}_{B,1} \geqslant p^*_{B,r}$ or …. In any of the possible intermediate cases, but for only those classes that have not been accepted at the first sample, a second set of random samples is drawn and combined estimates of the process fraction nonconforming are calculated and compared with the corresponding combined acceptability constants. If all such combined estimates are less than or equal to their respective combined acceptability constants, the lot is acceptable; otherwise, it is not acceptable.

NOTE 1 If there is more than one class of nonconformity, class A will contain nonconformities of the greatest level of seriousness and generally have the lowest AQL and therefore the lowest Form p^* acceptability constants; class B will contain nonconformities of the next lower level of seriousness and have a higher AQL and values of p^* and so on.

NOTE 2 It is possible that different classes of nonconformity will be under inspection at different levels of severity at any one time.

Annex B
(informative)

Standard multivariate "σ" method procedures for double sampling with independent quality characteristics

B.1 Procedure for a single class of nonconformity

The general method of dealing with a single class of m independent quality characteristics when the process standard deviation of all of the characteristics is known is as follows.

a) For each characteristic that has double specification limits, calculate the MPSD as if it were the only characteristic and check that the corresponding process standard deviation does not exceed it. If one or more process standard deviations exceeds its corresponding MPSD, the lot shall be considered non-acceptable and sampling inspection activities shall be discontinued until credible evidence has been produced to substantiate any assertion by the producer that he has sufficiently reduced the offending process standard deviation(s).

b) If none of the process standard deviations exceeds its MPSD, enter Table 9 with the lot size and inspection level in order to determine the sample size code letter.

c) Depending on the inspection severity, enter Table 26, 27 or 28 with the sample size code letter and the AQL applying to the class in order to determine the double sample sizes n and the acceptability constants p_a^*, p_r^* and p_c^*.

d) Select a sample of size n at random from the lot, measure the m quality characteristics on each item of the sample and calculate the m sample means.

e) Determine the estimated process fraction nonconforming in the first sample for each of the m characteristics in accordance with the procedures in Clause 17.

Denoting the estimated process fraction nonconforming for the ith quality characteristic by $\hat{p}_{1,i}$, the estimated process fraction nonconforming from the first sample for the whole class is calculated as

$$\hat{p}_1 = 1-(1-\hat{p}_{1,1})(1-\hat{p}_{1,2})\ldots(1-\hat{p}_{1,m}),$$

i.e. one minus the product of the estimated process fractions *conforming*.

NOTE If $\hat{p}_{1,1}, \hat{p}_{1,2}, \ldots, \hat{p}_{1,m}$ are all small, then $\hat{p}_1$ is approximately equal to the sum of the individual estimates, i.e. $\hat{p}_1 \cong \hat{p}_{1,1} + \hat{p}_{1,2} + \ldots + \hat{p}_{1,m}$.

The lot is accepted if $\hat{p}_1 \leqslant p_a^*$ or non-accepted if $\hat{p}_1 \geqslant p_r^*$. If $p_a^* < \hat{p}_1 < p_r^*$, a second random sample of size n is selected and measurements made of all m quality characteristics on all items in the sample. Then, for each characteristic, the means of both samples are combined, and a combined estimate of the process fraction nonconforming of the characteristic is calculated. Denoting these combined estimates by $\hat{p}_{c,1}, \hat{p}_{c,2}, \ldots, \hat{p}_{c,m}$, the estimated process fraction nonconforming from the combined samples for the whole class is given by

$$\hat{p}_c = 1-(1-\hat{p}_{c,1})(1-\hat{p}_{c,2})\ \ldots\ (1-\hat{p}_{c,m}).$$

The lot is then acceptable if $\hat{p}_c \leqslant p_c^*$ and non-acceptable if $\hat{p}_c > p_c^*$.

B.2 Procedure for more than one class of nonconformity

The procedure becomes more complicated if there are two or more classes of nonconformity. If there are several classes, say class A, class B, etc., then some further notation is helpful. Suppose that the estimated process fractions nonconforming for the classes are denoted by $\hat{p}_{A,1}$, $\hat{p}_{B,1}$, ... for the first set of samples and, when required, denoted by $\hat{p}_{A,c}$, $\hat{p}_{B,c}$, ... for the combined samples. Suppose also that the sample sizes and acceptability constants are denoted by n_A, $p^*_{A,a}$, $p^*_{A,r}$ and $p^*_{A,c}$ for class A, n_B, $p^*_{B,a}$, $p^*_{B,r}$ and $p^*_{B,c}$ for class B, etc. The lot is acceptable after the first set of samples if $\hat{p}_{A,1} \leqslant p^*_{A,a}$ and $\hat{p}_{B,1} \leqslant p^*_{B,a}$ and … but not acceptable if $\hat{p}_{A,1} \geqslant p^*_{A,r}$ or $\hat{p}_{B,1} \geqslant p^*_{B,r}$ or …. In any of the possible intermediate cases, but for only those classes that have not been accepted at the first sample, a second set of random samples is drawn and combined estimates of the process fraction nonconforming are calculated and compared with the corresponding combined acceptability constants. If all such combined estimates are less than or equal to their respective combined acceptability constants, the lot is acceptable; otherwise, it is not acceptable.

NOTE 1 If there is more than one class of nonconformity, class A will contain nonconformities of the greatest level of seriousness and generally have the lowest AQL and therefore the lowest Form p^* acceptability constants; class B will contain nonconformities of the next lower level of seriousness and have a higher AQL and values of p^*, and so on.

NOTE 2 It is possible that different classes of nonconformity will be under inspection at different levels of severity at any one time.

Annex C
(informative)

Standard multivariate combined "s" and "σ" method procedures for double sampling with independent quality characteristics

C.1 General

The double sampling plans in Tables 23 to 25 and Tables 26 to 28 were deliberately constructed to have, as far as possible, the same sets of values of the Form p^* acceptability constants, although the sample sizes differ. Consequently, when some of the process standard deviations in a class are known and some are unknown, it is possible to carry out a similar acceptance test to when the process standard deviations are all known or when they are all unknown.

C.2 Procedure for a single class of nonconformity

The general method of dealing with a single class of m independent quality characteristics when the process standard deviation of some of the characteristics is known and some are unknown is as follows.

a) For each characteristic that has double specification limits for which the process standard deviation is known, calculate the MPSD as if it were the only characteristic and check that the corresponding process standard deviation does not exceed it. If one or more of these process standard deviations exceeds its corresponding MPSD, the lot shall be considered non-acceptable and sampling inspection activities shall be discontinued until credible evidence has been produced to substantiate any assertion by the producer that he has sufficiently reduced the offending process standard deviation(s).

b) If none of the process standard deviations exceeds its MPSD, enter Table 9 with the lot size and inspection level in order to determine the sample size code letter.

c) Depending on the inspection severity, enter Table 23 and 26, or 24 and 27, or 25 and 28 with the sample size code letter and the AQL applying to the class in order to determine the double sample sizes n_s (for the case of unknown process standard deviations) and n_σ (for the case of known process standard deviation) and the acceptability constants p_a^*, p_r^* and p_c^* (for both cases).

d) Select an initial sample of size n_s at random from the lot and determine the initial estimates of the process fractions nonconforming for each quality characteristic for which the process standard deviation is unknown, as described in A.1. Also select an initial sample of size n_σ at random from the lot and determine the initial estimates of the process fractions nonconforming for each quality characteristic for which the process standard deviation is known, as described in B.1. Then construct the estimate of the overall process fraction nonconforming as

$$\hat{p}_1 = 1-(1-\hat{p}_{1,1})(1-\hat{p}_{1,2})\ldots(1-\hat{p}_{1,m}),$$

for all m quality characteristics taken together.

NOTE If $\hat{p}_{1,1}$, $\hat{p}_{1,2}$, ..., $\hat{p}_{1,m}$ are all small, then $\hat{p}_1$ is approximately equal to the sum of the individual estimates, i.e. $\hat{p}_1 \cong \hat{p}_{1,1} + \hat{p}_{1,2} + \ldots + \hat{p}_{1,m}$.

The lot is accepted if $\hat{p}_1 \leqslant p_a^*$ or non-accepted if $\hat{p}_1 \geqslant p_r^*$. If $p_a^* < \hat{p}_1 < p_r^*$, a second pair of random samples of sizes n_s and n_σ is selected and combined estimates of the process fractions nonconforming for each quality characteristic produced. Denoting these combined estimates by $\hat{p}_{c,1}$, $\hat{p}_{c,2}$, ..., $\hat{p}_{c,m}$, the estimated process fraction nonconforming from the combined samples for the whole class is given by

$$\hat{p}_c = 1 - (1 - \hat{p}_{c,1})(1 - \hat{p}_{c,2}) \ldots (1 - \hat{p}_{c,m}).$$

The lot is then acceptable if $\hat{p}_c \leqslant p_c^*$ and non-acceptable if $\hat{p}_c > p_c^*$.

C.3 Procedure for more than one class of nonconformity

The procedure for more than one class of nonconformity is dealt with in a similar way to that described in **A.2** and **B.2**.

Annex D
(informative)

Location of text on key features

Table D.1 — Location of text on key features

	Single specification limit						Double specification limits with combined control					
	"s" method			"σ" method			"s" method			"σ" method		
	Clauses or subclauses	Tables	Charts	Clauses or subclauses	Tables	Charts	Clauses or subclauses	Tables	Charts	Clauses or subclauses	Tables	Charts
Normal inspection	**16.1**, **16.2**, **23.1**, **23.2**	9, 10, 23	A, C to R	**17.1**, **17.2**, **23.1**, **23.2**	9, 13	A, C to R[a]	**16.1**, **16.4**, **23.1**, **23.2**	9, 16, 22 (for $n = 3$), 23	A, C to R[a]	**17.1**, **17.4**, **23.1**, **23.2**	9, 13, 19, 26	A, C to R[a]
Switching between normal and tightened inspection	**21.1**, **21.2**	10, 11, 23, 24	C to R	**21.1**, **21.2**	13, 14, 26, 27	C to R[a]	**21.1**, **21.2**	16, 17, 23, 24	C to R[a]	**21.1**, **21.2**	19, 26, 27	C to R[a]
Switching between normal and reduced inspection	**21.1**, **21.4**	10, 12	C to R	**21.1**, **21.4**	13, 15	C to R[a]	**21.1**, **21.4**	16, 18, 23, 25	C to R[a]	**21.1**, **21.4**	19, 26, 28	C to R[a]
Switching between tightened and discontinued inspection	**22**	11	C to R	**22**	14	C to R[a]	**22**	17, 24	C to R[a]	**22**	19, 27	C to R[a]
Switching between the "s" and "σ" methods	**23.1**, **23.2**, **23.3**	29		**23.1**, **23.2**, **23.4**	29		**23.1**, **23.2**, **23.3**	29		**23.1**, **23.2**, **23.4**	29	

[a] But see **8.4**.

Table D.2 *(continued)*

	Double specification limits with separate control						Double specification limits with complex control					
	"s" method			"σ" method			"s" method			"σ" method		
	Clauses or subclauses	**Tables**	**Charts**	**Clauses or subclauses**	**Tables**	**Charts**	**Clauses or subclauses**	**Tables**	**Charts**	**Clauses or subclauses**	**Tables**	**Charts**
Normal inspection	**16.1**, **16.3**, **23.1**, **23.2**	9, 22 (for n = 3), 23	A, C to R[a]	**17.1**, **17.3**, **23.1**, **23.2**	9, 13, 20, 26	A, C to R[a]	**16.1**, **16.5**, **23.1**, **23.2**	9, 22 (for n = 3), 23	A, C to R[a]	**17.1**, **17.5**, **23.1**, **23.2**	9, 13, 21, 26	A, C to R[a]
Switching between normal and tightened inspection	**21.1**, **21.2**	23, 24	C to R[a]	**21.1**, **21.2**	13, 14, 20, 26, 27	C to R[a]	**21.1**, **21.2**	16, 17, 23, 24	C to R[a]	**21.1**, **21.2**	13, 14, 21, 26, 27	C to R[a]
Switching between normal and reduced inspection	**21.1**, **21.4**	23, 25	C to R[a]	**21.1**, **21.4**	13, 15, 20, 26, 28	C to R[a]	**21.1**, **21.4**	23, 25	C to R[a]	**21.1**, **21.4**	13, 15, 21, 26, 28	C to R[a]
Switching between tightened and discontinued inspection	**22**	24	C to R[a]	**22**	14, 20, 27	C to R[a]	**22**	24	C to R[a]	**22**	21, 27	C to R[a]
Switching between the "s" and "σ" methods	**23.1**, **23.2**, **23.3**	29		**23.1**, **23.2**, **23.4**	29		**23.1**, **23.2**, **23.3**	29		**23.1**, **23.2**, **23.4**	29	

[a] But see **8.4**.

Annex E
(normative)

Estimating the process fraction nonconforming

E.1 General

For technical reasons, minimum variance unbiased estimators (MVUEs) should be used to estimate the process fraction nonconforming from the sample results. The process fraction nonconforming is denoted by p and its estimator by $\hat{p}$. This annex presents the exact formula for $\hat{p}$ for the case of unknown process variability (the "s" method) and also for the case of known process variability (the "σ" method) for both single and double samples. Because the exact formula for $\hat{p}$ for the "s" method generally requires reference to tables or software for the distribution function of the symmetric beta distribution, an approximative formula is presented that only requires reference to tables of the standard normal distribution. This formula is accurate enough for all practical purposes for sample sizes greater than four. Accordingly, further details are presented to facilitate the application of the exact formula for the "s" method for sample sizes 3 and 4.

E.2 Notation

In the following, the distribution function of the symmetric beta distribution is denoted by

$$G_m(y) = \begin{cases} 0 & \text{if } y < 0, \\ \int_0^y \frac{t^{m-1}(1-t)^{m-1}}{B(m,m)} \, \mathrm{d}t & \text{if } 0 \leqslant y \leqslant 1, \\ 1 & \text{if } y > 1, \end{cases}$$

where $B(m,m) = \Gamma(m)\Gamma(m)/\Gamma(2m)$, where $\Gamma(m)$ is the complete gamma integral, i.e.

$$\Gamma(m) = \int_0^\infty x^{m-1} \mathrm{e}^{-x} \mathrm{d}x.$$

Also required is the distribution function of the standard normal distribution, denoted by

$$\Phi(y) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{y} \mathrm{e}^{-t^2/2} \mathrm{d}t.$$

E.3 Exact formulae for a single sample of size n

E.3.1 The exact MVUE estimator of p for the "s" method

The general formula for the estimator of the process fraction nonconforming beyond either of the specification limits, based on a single sample of size n when the process standard deviation is unknown, is

$$\hat{p} = G_{(n-2)/2} \left\{ \frac{1}{2} \left(1 - Q \frac{\sqrt{n}}{n-1} \right) \right\}$$

where Q is the quality statistic for that specification limit. Thus, for the lower specification limit,

$$\hat{p}_{L,1} = G_{(n-2)/2}\left\{\frac{1}{2}\left(1 - Q_{L,1}\frac{\sqrt{n}}{n-1}\right)\right\} = G_{(n-2)/2}\left\{\frac{1}{2}\left(1 - \frac{\bar{x}_1 - L}{s_1}\frac{\sqrt{n}}{n-1}\right)\right\},$$

whereas, for the upper specification limit,

$$\hat{p}_{U,1} = G_{(n-2)/2}\left\{\frac{1}{2}\left(1 - Q_{U,1}\frac{\sqrt{n}}{n-1}\right)\right\} = G_{(n-2)/2}\left\{\frac{1}{2}\left(1 - \frac{U - \bar{x}_1}{s_1}\frac{\sqrt{n}}{n-1}\right)\right\}.$$

For combined or complex control of double specification limits, the combined process fraction nonconforming is estimated after a single sample by the sum of these two estimates, i.e. $\hat{p}_1 = \hat{p}_{L,1} + \hat{p}_{U,1}$.

E.3.2 The exact MVUE estimator of p for the "σ" method

The general formula for the estimator of the process fraction nonconforming beyond a specification limit, based on a single sample of size n when the process standard deviation is known, is

$$\hat{p} = \Phi\left(-Q_1\sqrt{\frac{n}{n-1}}\right)$$

where Q_1 is the quality statistic for that specification limit. The formula for the lower specification limit is

$$\hat{p}_{L,1} = \Phi\left(-Q_{L,1}\sqrt{\frac{n}{n-1}}\right) = \Phi\left(\frac{L - \bar{x}_1}{\sigma}\sqrt{\frac{n}{n-1}}\right)$$

where σ is the process standard deviation whose value is presumed to be known.

The corresponding formula for the upper specification limit is

$$\hat{p}_{U,1} = \Phi\left(-Q_{U,1}\sqrt{\frac{n}{n-1}}\right) = \Phi\left(\frac{\bar{x}_1 - U}{\sigma}\sqrt{\frac{n}{n-1}}\right).$$

Again, when required, the combined process fraction nonconforming is estimated by the sum of these two estimates.

E.4 Exact formulae for a double sample with each sample of size n

E.4.1 The exact MVUE estimator of p for the "s" method

The general formula for the estimator of the process fraction nonconforming beyond either of the specification limits, based on two samples each of size n, when the process standard deviation is unknown, is

$$\hat{p} = G_{(N-3)/2}\left\{\tfrac{1}{2}\left(1 - Q_{\text{c}}\sqrt{N/\{(N-1)(N-2)\}}\right)\right\}$$

where $N = 2n$ and Q_{c} is the combined quality statistic for that specification limit. Thus, for the lower specification limit,

$$\hat{p}_{L,\text{c}} = G_{(N-3)/2}\left\{\tfrac{1}{2}\left(1 - Q_{L,\text{c}}\sqrt{N/\{(N-1)(N-2)\}}\right)\right\} = G_{(N-3)/2}\left\{\frac{1}{2}\left(1 - \frac{\bar{x}_{\text{c}} - L}{s_{\text{c}}}\sqrt{N/\{(N-1)(N-2)\}}\right)\right\}$$

whereas, for the upper specification limit,

$$\hat{p}_{U,\text{c}} = G_{(N-3)/2}\left\{\tfrac{1}{2}\left(1 - Q_{U,\text{c}}\sqrt{N/\{(N-1)(N-2)\}}\right)\right\} = G_{(N-3)/2}\left\{\frac{1}{2}\left(1 - \frac{U - \bar{x}_\text{c}}{s_\text{c}}\sqrt{N/\{(N-1)(N-2)\}}\right)\right\}.$$

For combined or complex control of double specification limits, the combined process fraction nonconforming is estimated after two samples of size n by the sum of these two estimates, i.e. $\hat{p}_\text{c} = \hat{p}_{L,\text{c}} + \hat{p}_{U,\text{c}}$.

E.4.2 The exact MVUE estimator of p for the "σ" method

The general formula for the estimator of the process fraction nonconforming beyond a specification limit, based on two samples each of size n when the process standard deviation is known, is

$$\hat{p} = \Phi\left(-Q_\text{c}\sqrt{\frac{N}{N-1}}\right)$$

where $N = 2n$ and Q_c is the combined quality statistic for that specification limit. Thus the formula for the lower specification limit is

$$\hat{p}_{L,\text{c}} = \Phi\left(-Q_{L,\text{c}}\sqrt{\frac{N}{N-1}}\right) = \Phi\left(\frac{L - \bar{x}_\text{c}}{\sigma}\sqrt{\frac{N}{N-1}}\right)$$

where σ is the process standard deviation whose value is presumed to be known. The corresponding formula for the upper specification limit is

$$\hat{p}_{U,\text{c}} = \Phi\left(-Q_{U,\text{c}}\sqrt{\frac{N}{N-1}}\right) = \Phi\left(\frac{\bar{x}_\text{c} - U}{\sigma}\sqrt{\frac{N}{N-1}}\right).$$

Again, the total process fraction nonconforming beyond both limits is estimated by the sum of these two estimates.

E.5 Approximative procedure for the "s" method when $n \geqslant 5$

If tables or software for the distribution function of the symmetric beta distribution are not available, the following procedure can be used to obtain an accurate approximation to $\hat{p}$ for the "s" method when the sample size is 5 or more.

a) Calculate $Q = (U - \bar{x})/s$ and/or $(\bar{x} - L)/s$.

b) Calculate $v = \frac{1}{2}\{1 - Q\sqrt{n}/(n-1)\}$ for a first sample, or $v = \frac{1}{2}\left[1 - Q\sqrt{N/\{(N-1)(N-2)\}}\right]$ for two samples combined, where $N = 2n$.

NOTE If $v \leqslant 0{,}0$, then steps c) to g) become redundant, as the value of $\hat{p}$ corresponding to this specification limit is immediately known to be zero.

c) Calculate $y = a_n \ln\{v/(1-v)\}$ where a_n is given in Table E.1.

d) Calculate $w = y^2 - 3$.

e) Set $m = n - 1$ for a single sample or set $m =$ – 2 for a double sample.

f) If $w \geqslant 0$, set $t = \dfrac{12my}{12m + w}$, otherwise set $t = \dfrac{12(m-1)y}{12(m-1) + w}$.

g) Look up $\hat{p} = \Phi(t)$ in the tables of the standard normal distribution function.

Table E.1 — Values of a_n

Sample size, n, for $\hat{p}_{s,1}$	Double sample sizes for $\hat{p}_{s,c}$	a_n	Sample size, n, for $\hat{p}_{s,1}$	Double sample sizes for $\hat{p}_{s,c}$	a_n	Sample size, n, for $\hat{p}_{s,1}$	Double sample sizes for $\hat{p}_{s,c}$	a_n	Sample size, n, for $\hat{p}_{s,1}$	Double sample sizes for $\hat{p}_{s,c}$	a_n
5	3	0,731 350	48		3,354 378	103	52	5,000 083	196		6,946 253
6		0,880 496	49	25	3,391 432	105	53	5,049 833	203	102	7,071 097
7	4	1,009 784	50		3,428 086	107	54	5,099 098	205	103	7,106 364
8		1,125 182	51	26	3,464 352	109	55	5,147 891	209	105	7,176 378
9	5	1,230 248	52		3,500 243	112		5,220 226	213	107	7,245 716
10		1,327 276	53	27	3,535 769	113	57	5,244 116	218		7,331 466
11	6	1,417 833	54		3,570 943	115	58	5,291 573	223	112	7,416 224
12		1,503 044	55	28	3,605 773	117	59	5,338 608	229	115	7,516 673
13	7	1,583 745	57	29	3,674 445	119	60	5,385 232	234		7,599 366
14		1,660 575	59	30	3,741 856	121	61	5,431 455	239	120	7,681 169
15	8	1,734 040	60		3,775 111	122		5,454 420	241	121	7,713 647
16		1,804 542	61	31	3,808 075	123	62	5,477 289	243	122	7,745 989
17	9	1,872 410	62		3,840 757	125	63	5,522 742	249	125	7,842 215
18		1,937 919	63	32	3,873 163	127	64	5,567 825	254		7,921 511
19	10	2,001 296	64		3,905 300	128		5,590 230	255	128	7,937 275
20		2,062 737	65	33	3,937 175	129	65	5,612 545	257	129	7,968 709
21	11	2,122 408	66		3,968 794	131	66	5,656 912	260		8,015 630
22		2,180 453	67	34	4,000 163	133	67	5,700 933	279	140	8,306 642
23	12	2,236 997	68		4,031 288	135	68	5,744 618	287	144	8,426 167
24		2,292 152	69	35	4,062 175	137	69	5,787 972	293	147	8,514 710
25	13	2,346 014	71	36	4,123 254	140		5,852 402	295	148	8,544 020
26		2,398 670	73	37	4,183 442	141	71	5,873 721	297	149	8,573 231
27	14	2,450 197	75	38	4,242 777	144		5,937 221	309	155	8,746 443
28		2,500 665	77	39	4,301 294	145	73	5,958 237	315	158	8,831 776
29	15	2,550 137	78		4,330 255	147	74	6,000 048	322		8,930 300
30		2,598 669	79	40	4,359 025	148		6,020 845	331	166	9,055 399
31	16	2,646 313	81	41	4,416 001	149	75	6,041 570	355	178	9,380 844
32		2,693 115	82		4,444 216	155	78	6,164 458	357	179	9,407 456
33	17	2,739 119	83	42	4,472 252	157	79	6,204 880	369	185	9,565 575
35	18	2,828 887	85	43	4,527 805	158		6,224 993	381	191	9,721 122
36		2,872 720	86		4,555 327	161	81	6,284 945	391	196	9,848 869
37	19	2,915 896	87	44	4,582 684	163	82	6,324 596	395	198	9,899 506
38		2,958 442	89	45	4,636 914	165	83	6,364 001	417	209	10,173 505
39	20	3,000 385	90		4,663 792	166		6,383 613	435	218	10,392 314
40		3,041 751	91	46	4,690 517	171	86	6,480 779	467	234	10,770 338
41	21	3,082 562	93	47	4,743 514	178		6,614 414	477	239	10,885 779
42		3,122 841	94		4,769 792	179	90	6,633 285	507	254	11,224 980
43	22	3,162 607	95	48	4,795 926	181	91	6,670 867	519	260	11,357 824
44		3,201 879	96		4,821 918	185	93	6,745 403	593	297	12,144 964
45	23	3,240 676	97	49	4,847 771	187	94	6,782 363	643	322	12,649 116
46		3,279 015	101	51	4,949 833	191	96	6,855 687			
47	24	3,316 910	102		4,975 022	193	97	6,892 056			

E.6 Simplified exact formula for $\hat{p}$ for the "s" method with $n = 3$

The "s" method estimator for a single sample of size 3 is

$$\hat{p} = G_{0,5}\left\{\tfrac{1}{2}\left(1 - Q_1 \tfrac{\sqrt{3}}{2}\right)\right\} \tag{E.1}$$

and for a combination of two samples each of size 3 is

$$\hat{p} = G_{1,5}\left\{\tfrac{1}{2}\left(1 - Q_\mathrm{c}\sqrt{\tfrac{3}{10}}\right)\right\} \tag{E.2}$$

Now

$$G_{0,5}(x) = \begin{cases} 0 & \text{if } x < 0, \\ \displaystyle\int_0^x \frac{t^{-\frac{1}{2}}(1-t)^{-\frac{1}{2}}}{B(\frac{1}{2},\frac{1}{2})}\,\mathrm{d}t & \text{if } 0 \leqslant x \leqslant 1, \\ 1 & \text{if } x > 1, \end{cases} \tag{E.3}$$

where

$$B(\tfrac{1}{2},\tfrac{1}{2}) = \Gamma(\tfrac{1}{2})\Gamma(\tfrac{1}{2})/\Gamma(1) = \sqrt{\pi}\sqrt{\pi}/1 = \pi.$$

Writing $t = \sin^2\theta$, Equation (E.3) becomes

$$G_{0,5}(x) = \begin{cases} 0 \\ \frac{2}{\pi}\displaystyle\int_0^{\sin^{-1}\sqrt{x}} \mathrm{d}\theta \\ 1 \end{cases} = \begin{cases} 0 & \text{if } x < 0, \\ \frac{2}{\pi}\sin^{-1}\sqrt{x} & \text{if } 0 \leqslant x \leqslant 1, \\ 1 & \text{if } x > 1. \end{cases} \tag{E.4}$$

Substituting Equation (E.4) in Equation (E.1) yields

$$\hat{p} = \begin{cases} 0 & \text{if } Q_1 > 2/\sqrt{3}, \\ \frac{2}{\pi}\sin^{-1}\sqrt{\frac{1}{2}\left(1 - Q_1\frac{\sqrt{3}}{2}\right)} & \text{if } -2/\sqrt{3} \leqslant Q_1 \leqslant 2/\sqrt{3}, \\ 1 & \text{if } Q_1 < -2/\sqrt{3}. \end{cases}$$

This is the quantity tabulated in Table 22.

Equation (E.2) can be evaluated in the same way as for a single sample by setting $n = 5$, $m = n - 1 = 4$ and $v = \frac{1}{2}\left(1 - Q_\mathrm{c}\sqrt{\frac{3}{10}}\right)$ in the equations in **E.5**.

E.7 Simplified exact formula for $\hat{p}$ for the "s" method with $n = 4$

The "s" method estimator for a single sample of size 4 is

$$\hat{p} = G_1\left\{\tfrac{1}{2}\left(1 - \tfrac{2}{3}Q_1\right)\right\} = G_1\left\{\tfrac{1}{2} - \tfrac{1}{3}Q_1\right\} \tag{E.5}$$

and for a combination of two samples each of size 4 is

$$\hat{p} = G_{2,5}\left\{\tfrac{1}{2}\left(1 - Q_c\sqrt{\tfrac{4}{21}}\right)\right\} = G_{2,5}\left\{\tfrac{1}{2} - Q_c / \sqrt{21}\right\}. \tag{E.6}$$

Now,

$$G_1(x) = \begin{cases} 0 & \text{if } x < 0, \\ \int_0^x \frac{\mathrm{d}t}{B(1,1)} & \text{if } 0 \leqslant x \leqslant 1, \\ 1 & \text{if } x > 1 \end{cases}$$

where

$$B(1,1) = \Gamma(1)\Gamma(1)/\Gamma(2) = 1.$$

$G_1(x)$ can therefore be written

$$G_1(x) = \begin{cases} 0 & \text{if } x < 0, \\ x & \text{if } 0 \leqslant x \leqslant 1, \\ 1 & \text{if } x > 1. \end{cases}$$

Hence, from Equation (E.5),

$$\hat{p} = \begin{cases} 0 & \text{if } Q_1 > 3/2, \\ \frac{1}{2} - \frac{1}{3}Q_1 & \text{if } -3/2 \leqslant Q_1 \leqslant 3/2, \\ 1 & \text{if } Q_1 < -3/2. \end{cases}$$

Equation (E.6) can be evaluated in the same way as a single sample by setting $n = 7$, $m = n - 1 = 6$ and $v = \frac{1}{2}\left(1 - Q_c / \sqrt{21}\right)$ in **E.5**.

Annex F
(informative)

Form k "s" method single sampling plans matched to the corresponding single sampling plans by attributes

F.1 This annex provides "s" method single sampling plans by variables that have been matched to the corresponding single sampling plans by attributes in ISO 2859-1. Tables are provided for normal, tightened and reduced inspection in Tables F.1, F.2 and F.3 respectively.

Table F.2 The purpose of including these tables is to identify the "s" method single sampling plans by variables against which the average sample sizes of the double sampling plans by variables are compared in Annex K.

Table F.1 — Matched single sampling plans of Form k for normal inspection — "s" method

Code letter	Acceptance quality limit (in percent nonconforming)															
	0,01	0,015	0,025	0,04	0,065	0,10	0,15	0,25	0,40	0,65	1,0	1,5	2,5	4,0	6,5	10,0
	n k	n k	n k	n k	n k	n k	n k	n k	n k	n k	n k	n k	n k	n k	n k	n k
B	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	3 0,950	4 0,735	4 0,586
C	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	4 1,242	6 1,061	6 0,939	4 0,536
D	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	6 1,476	9 1,323	9 1,218	6 0,887	6 0,497
E	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	9 1,696	13 1,569	13 1,475	9 1,190	9 0,869	9 0,618
F	↓	↓	↓	↓	↓	↓	↓	↓	↓	11 1,889	17 1,769	18 1,682	13 1,426	14 1,147	14 0,935	13 0,597
G	↓	↓	↓	↓	↓	↓	↓	↓	15 2,079	22 1,972	23 1,893	18 1,659	20 1,411	21 1,227	21 0,945	21 0,724
H	↓	↓	↓	↓	↓	↓	↓	18 2,254	28 2,153	30 2,079	24 1,862	27 1,636	30 1,471	32 1,225	33 1,036	33 0,806
J	↓	↓	↓	↓	↓	↓	23 2,425	36 2,331	38 2,263	31 2,061	37 1,853	41 1,702	46 1,482	49 1,316	52 1,120	53 0,911
K	↓	↓	↓	↓	↓	28 2,580	44 2,493	47 2,428	40 2,237	48 2,043	54 1,904	63 1,702	69 1,552	75 1,377	79 1,195	82 0,946
L	↓	↓	↓	↓	34 2,736	54 2,653	58 2,592	49 2,412	61 2,230	71 2,101	84 1,914	94 1,777	105 1,619	115 1,456	124 1,239	↑
M	↓	↓	↓	40 2,881	64 2,802	69 2,744	60 2,573	76 2,400	89 2,279	108 2,104	124 1,977	143 1,832	159 1,683	178 1,488	↑	↑
N	↓	↓	47 3,023	75 2,948	81 2,892	72 2,728	93 2,564	110 2,449	137 2,285	159 2,166	186 2,031	213 1,894	242 1,715	↑	↑	↑
P	↓	55 3,161	88 3,089	96 3,036	86 2,879	112 2,723	134 2,614	171 2,459	202 2,347	239 2,220	277 2,092	326 1,927	↑	↑	↑	↑
Q	63 3,288	101 3,219	110 3,167	100 3,016	132 2,867	159 2,762	207 2,615	244 2,508	293 2,388	348 2,268	424 2,114	↑	↑	↑	↑	↑
R	116 3,351	127 3,301	117 3,156	155 3,012	189 2,912	247 2,771	298 2,670	361 2,556	429 2,442	527 2,297	↑	↑	↑	↑	↑	↑

NOTE 1 The sample size code letters in this part of ISO 3951 correspond to those given in ISO 2859-1, ISO 3951-1 and ISO 3951-2.

NOTE 2 Symbols

↓ There is no suitable plan in this area; use the first sampling plan below the arrow. If the sample size equals or exceeds the lot size, carry out 100 % inspection.

↑ There is no suitable plan in this area; use the first sampling plan above the arrow.

Table F.2 — Matched single sampling plans of Form *k* for tightened inspection — "*s*" method

Code letter	Acceptance quality limit (in percent nonconforming)															
	0,01	0,015	0,025	0,040	0,065	0,10	0,15	0,25	0,40	0,65	1,0	1,5	2,5	4,0	6,5	10,0
	n *k*	*n* *k*	*n* *k*	*n* *k*	*n* *k*	*n* *k*	*n* *k*	*n* *k*	*n* *k*	*n* *k*	*n* *k*	*n* *k*	*n* *k*	*n* *k*	*n* *k*	*n* *k*
B	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	3 0,950	4 0,735
C	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	4 1,242	6 1,061	6 0,939
D	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	6 1,476	9 1,323	9 1,218	6 0,887
E	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	9 1,696	13 1,569	13 1,475	9 1,190	9 0,869
F	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	11 1,889	17 1,769	18 1,682	13 1,426	14 1,147	14 0,935
G	↓	↓	↓	↓	↓	↓	↓	↓	↓	15 2,079	22 1,972	23 1,893	18 1,659	20 1,411	21 1,227	21 0,945
H	↓	↓	↓	↓	↓	↓	↓	↓	18 2,254	28 2,153	30 2,079	24 1,862	27 1,636	30 1,471	32 1,225	33 0,954
J	↓	↓	↓	↓	↓	↓	↓	23 2,425	36 2,331	38 2,263	31 2,061	37 1,853	41 1,702	46 1,482	50 1,245	53 1,010
K	↓	↓	↓	↓	↓	↓	28 2,580	44 2,493	47 2,428	40 2,237	48 2,043	54 1,904	63 1,702	71 1,489	78 1,281	82 1,045
L	↓	↓	↓	↓	↓	34 2,736	54 2,653	58 2,592	49 2,412	61 2,230	71 2,101	84 1,914	99 1,720	111 1,533	122 1,325	↑
M	↓	↓	↓	↓	40 2,881	64 2,802	69 2,744	60 2,573	76 2,400	89 2,279	108 2,104	131 1,924	150 1,752	170 1,564	↑	↑
N	↓	↓	↓	47 3,023	75 2,948	81 2,892	72 2,728	93 2,564	110 2,449	137 2,285	169 2,117	201 1,958	233 1,785	↑	↑	↑
P	↓	↓	55 3,161	88 3,089	96 3,036	86 2,879	112 2,723	134 2,614	171 2,459	214 2,300	256 2,151	306 1,991	↑	↑	↑	↑
Q	↓	63 3,288	101 3,219	110 3,167	100 3,016	132 2,867	159 2,762	207 2,615	262 2,464	323 2,324	395 2,174	↑	↑	↑	↑	↑
R	72 3,417	116 3,351	127 3,301	117 3,156	155 3,012	189 2,912	247 2,771	320 2,628	397 2,495	498 2,354	↑	↑	↑	↑	↑	↑

NOTE 1 The sample size code letters in this part of ISO 3951 correspond to those given in ISO 2859-1, ISO 3951-1 and ISO 3951-2.

NOTE 2 Symbols

↓ There is no suitable plan in this area; use the first sampling plan below the arrow. If the sample size equals or exceeds the lot size, carry out 100 % inspection.

↑ There is no suitable plan in this area; use the first sampling plan above the arrow.