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Sampling procedures for inspection by attributes —

Part 4: Procedures for assessment of stated quality levels

Règles d'échantillonnage pour les contrôles par attributs —
Partie 4: Procédures pour l'évaluation des niveaux spécifiés de qualité

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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 3.

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 part of ISO 2859 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 2859-4 was prepared by Technical Committee ISO/TC 69, *Applications of statistical methods*, Subcommittee SC 5, *Acceptance sampling*.

ISO 2859 consists of the following parts, under the general title *Sampling procedures for inspection by attributes*:

— *Part 0: Introduction to the ISO 2859 attribute sampling system*

— *Part 1: Sampling schemes indexed by acceptable quality level (AQL) for lot-by-lot inspection*

— *Part 2: Sampling plans indexed by limiting quality (LQ) for isolated lot inspection*

— *Part 3: Skip-lot sampling procedures*

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

Annex A of this International Standard is given for information only.

Introduction

The procedures in this part of ISO 2859 differ in their scope from the procedures in ISO 2859 Parts 1 to 3. The system of acceptance sampling procedures that are specified in ISO 2859 Parts 1 to 3 are intended to be used in bilateral agreements between two parties. The acceptance sampling procedures are intended to be used as simple, pragmatic rules for releasing product after inspection of only a limited sample of a consignment, and therefore the procedures do not make reference (either explicitly or implicitly) to any formally declared quality level.

Under acceptance sampling there is no sharp borderline between quality levels that should be considered acceptable and qualities that should be rejected by the procedure. For the procedures in ISO 2859-1 the two parties agree upon some limiting quality level (AQL) which is the worst tolerable process average when a continuing series of lots is submitted. The switching rules and the sampling schemes in ISO 2859-1 are designed to encourage the suppliers to have process averages consistently better than the AQL selected. In order to keep sample sizes moderate, the protection against accepting individual lots of inferior quality may be less than that provided by sampling plans targeted for sentencing individual lots. The procedures in ISO 2859-2, on the contrary, are designed to provide good protection against accepting individual lots of inferior quality (LQ), but at the expense of a possible high risk of not accepting lots of qualities that both parties actually would consider to be acceptable.

Procedures in these parts of ISO 2859 are well suited for acceptance sampling purposes, but they should not be used in reviews, audits, etc. to verify a quality that has been declared for some entity. The main reason is that the procedures have been indexed in terms of quality levels that are relevant solely for the pragmatic purposes of acceptance sampling, and the various risks have been balanced accordingly.

The procedures in the present part of ISO 2859 have been developed as a response to the growing need for sampling procedures suitable for formal, systematic inspections such as reviews or audits. When performing such a formal inspection, the authority shall consider the risk of reaching an incorrect conclusion, and take this risk into account in planning and executing the review/audit/testing, etc.

This International Standard provides guidance and rules to assist the user in taking this risk into account in an informed manner.

The rules in this International Standard have been devised such that there is only a small, limited risk of contradicting the declared quality level when in fact the actual level conforms to the declared level.

If it were also desired that there should be a similarly small risk of not contradicting the declared quality level when in fact the actual quality level does not conform to the declared quality level, then it would be necessary to investigate a rather large sample. Therefore, in order to obtain the benefit of a moderate sample size, the procedures in this International Standard have been devised in such a way that they allow a somewhat higher risk of failing to contradict the declared quality level when in fact the actual quality level does not conform to the declared quality level.

The wording of the result of the assessment should reflect this unbalance between the risks of reaching incorrect conclusions.

When the sample result contradicts the declared quality level *there is strong evidence of nonconformance to the declared quality level.*

When the sample result does not contradict the declared quality level, this should be understood as “we have not, in this limited sample, found strong evidence of nonconformance to the declared quality level”.

Sampling procedures for inspection by attributes —

Part 4:
Procedures for assessment of stated quality levels

1 Scope

This part of ISO 2859 establishes sampling plans and procedures that can be used to assess whether the quality level of an entity (lot, process, etc) conforms to a declared value. The sampling plans have been devised so as to obtain a risk of less than 5 % of contradicting a correct declared quality level. The risk is 10 % of failing to contradict an incorrect declared quality level which is related to the limiting quality ratio (see clause 4). Sampling plans are provided corresponding to three levels of discriminatory ability.

In contrast to the procedures in the other parts of ISO 2859, the procedures in this part of ISO 2859 are not applicable to acceptance assessment of lots. Generally, the balancing of the risks of reaching incorrect conclusions in assessment procedures will differ from the balancing in the procedures for acceptance sampling.

This part of ISO 2859 may be used for various forms of quality inspection in situations where objective evidence of conformity to some declared quality level is to be provided by means of inspection of a sample. The procedures are applicable to entities such as lots, process output, etc. that allow random samples of individual items to be taken from the entity.

The sampling plans provided in this part of ISO 2859 are applicable, but not limited, to inspection of a variety of products such as

a) end items;

b) components and raw materials;

c) operations;

d) materials in process;

e) supplies in storage;

f) maintenance operations;

g) data or records;

h) administrative procedures.

The procedures are primarily intended to be used when the quantity of interest is the number or fraction of nonconforming items, for which the inspected items are classified as conforming or nonconforming.

With minor changes the procedures may also be used when the quantity of interest is the number of nonconformities or number of nonconformities per item. The necessary changes are:

— replacement of “number of nonconforming items’’ by “number of nonconformities’’

— replacement of “percent nonconforming items’’ by “nonconformities per 100 items’’.

In this case the values given in Tables 1 to 3 and Tables 5 to 7 are only approximations.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 2859. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 2859 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 3534-1:1993, *Statistics — Vocabulary and symbols — Part 1: Probability and general statistical terms.*

ISO 3534-2:1993, *Statistics — Vocabulary and symbols — Part 2: Statistical quality control.*

ISO 8402:1994, *Quality management and quality assurance — Vocabulary.*

3 Terms, definitions, symbols and abbreviations

3.1 Terms and definitions

For the purposes of this part of ISO 2859, the terms and definitions given in ISO 3534-1, ISO 3534-2 and ISO 8402 and the following apply.

3.1.1
limiting number of nonconforming items
L
largest number of nonconforming items (or nonconformities) found in the sample from the entity under investigation that does not lead to contradiction of the declared quality level

3.1.2
quality ratio
ratio of the actual to the declared quality level of the entity under investigation

3.1.3
limiting quality ratio
LQR
value of the quality ratio that is limited to a small risk (10 % in this part of ISO 2859) of failing to contradict an incorrect declared quality level

3.2 Symbols and abbreviated terms

The symbols and abbreviated terms used in this International Standard are as follows:

DQL	Declared quality level
L	Limiting number of nonconforming items in the sample
LQR	Limiting quality ratio
n	Sample size

4 Principles

In any assessment procedure based on sampling there will be an inherent uncertainty due to possible sampling fluctuations.

The procedures in this part of ISO 2859 have been conceived so as to lead to contradiction of the declared quality level only when there is sufficient evidence to support a conclusion that the actual quality is poorer than the declared quality level.

The procedures have been devised in such a way that when the actual quality level is equal to or better than the declared quality level, the risk is less than 5 % of contradicting the declared value. Consequently, when the actual quality level is worse than the declared quality level, there is a risk that the procedures will fail to contradict an incorrect declared quality level.

This risk depends on the value of the quality ratio, i.e. the ratio between the actual and the declared quality level. The limiting quality ratio, LQR, is introduced to denote the highest quality ratio considered tolerable. When the actual quality level is LQR times worse than the declared quality level, the procedures in this International Standard have a risk of 10 % of failing to contradict the declared quality level (corresponding to a 90 % probability of contradicting the incorrect declared quality level).

Three LQR levels I, II and III are considered. Details of the three LQR levels provided in this part of ISO 2859 are given in 6.1.

The sampling plans provided in this part of ISO 2859 are indexed by the limiting quality ratio (LQR) level and the declared quality level (DQL).

5 Declared quality level (DQL)

The DQL together with the LQR level is used for indexing the sampling plans provided in this part of ISO 2859. The values of DQL in the tables are known as preferred DQL's. The series of preferred DQL values correspond to the series of preferred AQL's for inspection for nonconforming items in ISO 2859-1.

There shall be a sound basis for the DQL used. The DQL shall not be deliberately overstated or understated.

When a DQL is designated for a certain type of nonconformity, it indicates that the supplier has good reason to believe that the quality is not worse than this designated value.

CAUTION — When the DQL is estimated from a sample taken from the entity of interest, the procedures in this International Standard shall not be used. Such a verification of an estimate from a sample requires that the sample size and inspection result be taken into account in order to incorporate the uncertainty associated with the estimate. This uncertainty affects the assessment of the risks of making incorrect conclusions on the actual status of the entity of interest. Such verification usually requires larger sample sizes than those used in the procedures described in this International Standard.

6 Sampling plans

6.1 LQR (limiting quality ratio) levels

6.1.1 Level I

Level I may be used when a smaller sample size is desirable. For level I sampling plans, the limiting quality ratios range in value from 10,7 to 13,0. For example, if the declared quality level is 0,10 % nonconforming items, and the actual quality level is 12,3 times worse than this declared quality level, then the risk is 10 % for failing to contradict the declared quality level (see Table 1).

6.1.2 Level II

Level II is the standard level that shall be used unless specific conditions warrant the use of another level. For level II sampling plans, the limiting quality ratios range in value from 5,54 to 7,07. For example, if the declared

quality level is 0,10 % nonconforming items, and the actual quality level is 6,64 times worse than this declared quality level, then the risk is 10 % for failing to contradict the declared quality level (see Table 2).

6.1.3 Level III

Level III is for situations where a smaller LQR is desired, at the expense of a larger sample size. For level III sampling plans, the limiting quality ratios range in value from 4,44 to 5,55. For example, if the declared quality level is 0,10 % nonconforming items, and the actual quality level is 5,34 times worse than this declared quality level, then the risk is 10 % for failing to contradict the declared quality level (see Table 3).

Table 1 — Limiting quality ratio (LQR) and probability of falsely contradicting a correct declared quality level (DQL) — LQR level I plans.

DQL % nonconforming items	n	L	LQR	Probability of falsely contradicting a correct DQL %
0,010	3 150	1	12,3	4,0
0,015	2 000	1	13,0	3,7
0,025	1 250	1	12,4	4,0
0,040	800	1	12,1	4,1
0,065	500	1	11,9	4,3
0,10	315	1	12,3	4,0
0,15	200	1	12,9	3,7
0,25	125	1	12,3	4,0
0,40	80	1	11,9	4,1
0,65	50	1	11,6	4,2
1,0	32	1	11,6	4,1
1,5	20	1	12,1	3,6
2,5	13	1	10,7	4,1
EXAMPLE Suppose the plan is n = 315, L = 1, corresponding to a declared quality level (DQL) of 0,1 % nonconforming items is used. For this plan there is a 10 % risk of failing to contradict this DQL when the actual quality level is 12,3 (LQR) times worse than the declared quality level, i.e. if the actual quality level is 1,23 % nonconforming items. If, on the contrary, the actual quality level had been the DQL, i.e. if the actual quality level is 0,1 % nonconforming items, then there is a risk of 4,0 % of falsely contradicting this correct DQL.				

Table 2 — Limiting quality ratio (LQR) and probability of falsely contradicting a correct declared quality level (DQL) — LQR level II plans.

DQL % nonconforming items	n	L	LQR	Probability of falsely contradicting a correct DQL %
0,025	3 150	2	6,75	4,6
0,040	2 000	2	6,65	4,7
0,065	1 250	2	6,54	4,9
0,10	800	2	6,64	4,7
0,15	500	2	7,07	4,0
0,25	315	2	6,72	4,5
0,40	200	2	6,60	4,7
0,65	125	2	6,46	4,9
1,0	80	2	6,52	4,7
1,5	50	2	6,86	3,9
2,5	32	2	6,31	4,5
4,0	20	2	6,12	4,4
6,5	13	2	5,54	4,8

EXAMPLE Suppose the plan is n = 800, L = 2, corresponding to a declared quality level (DQL) of 0,1 % nonconforming items is used. For this plan there is a 10 % risk of failing to contradict this DQL when the actual quality level is 6,64 (LQR) times worse than the declared quality level, i.e. if the actual quality level is 0,664 % nonconforming items.

If, on the contrary, the actual quality level had been the DQL, i.e. if the actual quality level is 0,1 % nonconforming items, then there is a risk of 4,7 % of falsely contradicting this correct DQL.

Table 3 — Limiting quality ratio (LQR), and probability of falsely contradicting a correct declared quality level (DQL) — LQR level III plans.

DQL % nonconforming items	n	L	LQR	Probability of falsely contradicting a correct DQL %
0,040	3 150	3	5,30	3,9
0,065	2 000	3	5,13	4,3
0,10	1 250	3	5,34	3,8
0,15	800	3	5,55	3,4
0,25	500	3	5,32	3,8
0,40	315	3	5,27	3,9
0,65	200	3	5,09	4,3
1,0	125	3	5,27	3,7
1,5	80	3	5,44	3,3
2,5	50	3	5,15	3,6
4,0	32	3	4,92	3,8
6,5	20	3	4,68	3,7
10,0	13	3	4,44	3,4

EXAMPLE Suppose the plan is n = 1 250, L = 3, corresponding to a declared quality level (DQL) of 0,1 % nonconforming items is used. For this plan there is a 10 % risk of failing to contradict this DQL when the actual quality level is 5,34 (LQR) times worse than the declared quality level, i.e. if the actual quality level is 0,534 % nonconforming items.

If, on the contrary, the actual quality level had been the DQL, i.e. if the actual quality level is 0,1 % nonconforming items, then there is a risk of 3,8 % of falsely contradicting this correct DQL.