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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

bsi.

National foreword

This British Standard is the UK implementation of ISO 3951-1:2022. It supersedes BS ISO 3951-1:2013, which is withdrawn.

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A list of organizations represented on this committee can be obtained on request to its committee manager.

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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

Règles d'échantillonnage pour les contrôles par mesures —

Partie 1: Spécification pour les plans d'échantillonnage simples indexés d'après un niveau de qualité acceptable (NQA) pour un contrôle lot par lot pour une caractéristique qualité unique et un NQA unique

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

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

This third edition cancels and replaces the second edition (ISO 3591-1:2013), which has been technically revised.

The main changes are as follows:

— procedures have been introduced to accommodate measurement uncertainty;

— many of the sampling plans have been adjusted to improve the match between their operating characteristic curves and the operating characteristic curves of the corresponding plans for single sampling by attributes in ISO 2859-1.

A list of all parts in the ISO 3951 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

This document specifies an acceptance sampling system of single sampling plans for inspection by variables. It is indexed in terms of the acceptance quality limit (AQL). A more comprehensive and technical treatment of the AQL scheme is given in ISO 3951-2. This document is complementary to ISO 2859-1.

The objectives of the methods laid down in this document are to ensure that lots of acceptable quality have a high probability of acceptance and that the probability of not accepting inferior lots is as high as practicable. This is achieved by means of the switching rules, which provide the following:

a) an 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

b) 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 document, the acceptance of a lot is implicitly determined from an estimate of the percentage of nonconforming items in the process, based on a random sample of items from the lot.

This document is intended for application 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, this document is applied to each one separately.

This document is intended for application to a single quality characteristic that is measurable on a continuous scale and is normally distributed. For two or more such quality characteristics, see ISO 3951-2. For information on normality and data transformations, see Clause 12.

It is assumed in the body of this document that measurement error is negligible (see ISO 10576-1:2003). For information on allowing for measurement error, see Annex B.

For double specification limits, this document covers combined control. For other types of control, refer to ISO 3951-2.

CAUTION — The procedures in this document are not suitable for application to lots that have been screened for nonconforming items.

Inspection by variables for nonconforming items, as described in this document, includes several possible modes, the combination of which leads to a presentation that may appear quite complex to the user:

— unknown standard deviation, or originally unknown then estimated with fair precision, or known since the start of inspection;

— a single specification limit, or combined control of double specification limits;

— normal inspection, tightened inspection, or reduced inspection.

The choice of the most suitable variables plan, if one exists, requires experience, judgement, and some knowledge of both statistics and the product to be inspected. Clause 5 of this document is intended to help those responsible for specifying sampling plans in making this choice. They suggest the considerations that should be kept in mind when deciding whether a variables plan is suitable and the choices to be made when selecting an appropriate standard plan.

The basic definitions and notations are provided in Clauses 3 and 4. The basic operational rules are contained in Clauses 5 through 9. Clause 10 informs about the relations between this document and the attributes sampling standard ISO 2859-1. Clauses 11, 12 and 13 provide background on accounting for measurement uncertainty, the normality assumption, and monitoring of inspection results and the underlying process. All tables needed for the sampling procedure can be found in Clause 14 and examples for the s–method and the σ–method for both one and two specification limits can be found in Clause 15.

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Nine annexes are provided. Annex A indicates how the sample standard deviation, s, and the presumed known value of the process standard deviation, σ, should be determined. Annex B provides procedures for accommodating measurement uncertainty. Annex C shows five different sampling strategies. Annex D gives the general formula for the operating characteristic of the σ–method and provides tables with values of the operating characteristics of single sampling plans with known σ. Annex E gives the general formula for the operating characteristic of the s–method and provides tables with values of the operating characteristics of single sampling plans with unknown σ. Annex F provides the statistical theory underlying the calculation of the consumer's risk qualities, together with tables showing these quality levels for normal, tightened, and reduced inspection, as well as for the s–method and σ–method. Annex G provides similar information for the producer's risks. Annex H give details of how Acceptance diagrams for double specification limits are constructed, Annex I shows the use of the underlying software (R package to support implementation of this document).

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INTERNATIONAL STANDARD **ISO 3951-1:2022(E)**

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

1 Scope

This document specifies single sampling plans for lot-by-lot inspection under the following conditions:

a) where the inspection procedure is applied to a continuing series of lots of discrete products, all supplied by one producer using one production process;

b) where only a single quality characteristic, x, of these products is taken into consideration, which is measurable on a continuous scale;

c) where production is under statistical control and the quality characteristic, x, is distributed according to a normal distribution or a close approximation to the normal distribution;

d) where a contract or standard defines a lower specification limit, L, an upper specification limit, U, or both. An item is qualified as conforming if its measured quality characteristic, x, satisfies as appropriate one of the following inequalities:

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

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

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

Inequalities 1) and 2) are cases with a single specification limit, and 3) is a case with double specification limits.

Where double specification limits apply, it is assumed in this document that conformity to both specification limits is equally important to the integrity of the product. In such cases, it is appropriate to apply a single AQL to the combined percentage of a product outside the two specification limits. This is referred to as combined control.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 2859-1, *Sampling procedures for inspection by attributes — Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection*

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

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

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