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Sampling procedures for inspection by variables —

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

Règles d'échantillonnage pour les contrôles par mesures —

Partie 5: Plans d'échantillonnage séquentiels indexés d'après la limite d'acceptation de qualité (LAQ) pour l'inspection par variables (écart-type connu)

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Foreword

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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.

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

This edition cancels and replaces Annex A of ISO 8423:1991, which has been technically revised to greatly improve its compatibility with the sampling systems in ISO 3951-1.

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

The following parts are under preparation:

⎯ *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*

Introduction

In contemporary production processes, quality is often expected to reach such high levels that the number of nonconforming items is reported in parts per million. Under such circumstances, popular acceptance sampling plans by attributes, such as those presented in ISO 2859-1, require prohibitively large sample sizes. When it is possible to apply acceptance sampling plans by variables, such as those presented in ISO 3951-1, the sample sizes are much smaller. However, especially in the case of acceptance of a product of extremely high quality, those sample sizes are still too large. Therefore, there is a need to apply standardized statistical procedures that require the smallest possible sample sizes. Sequential sampling plans are the only statistical procedures that satisfy that need. It has been mathematically proved that among all possible sampling plans having similar statistical properties, the sequential sampling plan has the smallest average sample size. Therefore, there is a strong need to present sequential sampling plans which are statistically equivalent to the commonly used acceptance sampling plans from ISO 3951-1, but which require significantly smaller average sample sizes.

The principal advantage of sequential sampling plans is the reduction in the average sample size. The *average sample number* is the average of all the sample sizes that may occur under a sampling plan for a given lot or process quality level. The use of sequential sampling plans leads to a smaller average sample number than single sampling plans having the equivalent operating characteristic. For the sequential sampling plans in this part of ISO 3951, a curtailment rule has been introduced involving an upper limit of 1,5 n_0 on the actual number of items to be inspected, where n_0 is the sample size of the corresponding single sampling plan.

Other factors that should be taken into account are as follows:

a) Complexity

    The rules of a sequential sampling plan are more easily misunderstood by inspectors than the simple rules for a single sampling plan.

b) Variability in the amount of inspection

    As the actual number of items inspected for a particular lot is not known in advance, the use of sequential sampling plans brings about various organizational difficulties. For example, scheduling of inspection operations may be difficult.

c) Ease of drawing sample items

    If drawing sample items is at different times rather difficult, the reduction in the average sample size by sequential sampling plans may be cancelled out by the increased sampling cost.

d) Duration of test

    If the test of a single item is of long duration and a number of items can be tested simultaneously, sequential sampling plans are much more time-consuming than the corresponding single sampling plans.

e) Variability of quality within the lot

    If the lot consists of two or more sublots from different sources and if there is likely to be any substantial difference between the qualities of the sublots, drawing of a random sample under a sequential sampling plan is more awkward than under the corresponding single sampling plan.

The balance between the advantage of a smaller average sample number of the sequential sampling plan and the above disadvantages leads to the conclusion that sequential sampling plans are suitable only when inspection of individual items is costly in comparison with inspection overheads.

The choice between single and sequential sampling plans should be made before the inspection of a lot is started. During inspection of a lot, it is not permitted to switch from one type of plan to another, because the operating characteristics of the plan may be drastically changed if the actual inspection results influence the choice of acceptability criteria.

Although a sequential sampling plan is on average much more economical than the corresponding single sampling plan, it may occur, during inspection of a particular lot, that acceptance and non-acceptance comes at a very late stage because the cumulative leeway (the statistic used for the determination of lot acceptability) remains between the acceptance value and the rejection value for a long time. With the graphical method, this corresponds to the random progress of the step-wise linear curve remaining in the indecision zone.

In order to alleviate this disadvantage, the sample size curtailment value is set before the inspection of a lot is started, and inspection terminates if the cumulative sample size reaches the curtailment value, n_t, without determination of lot acceptability. The acceptance and non-acceptance of the lot is then determined using the curtailment acceptance and rejection values.

For sequential sampling plans in common use, curtailment usually represents a deviation from their intended usage, leading to a distortion of their operating characteristics. In this part of ISO 3951, however, the operating characteristics of the sequential sampling plans have been determined with curtailment taken into account, so curtailment is an integral component of the provided plans.