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Capability of detection —

Part 7: Methodology based on stochastic properties of instrumental noise

Capacité de détection —

Partie 7: Méthodologie basée sur les propriétés stochastiques du bruit instrumental

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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 document 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).

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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 6, *Measurement methods and results*.

This third edition cancels and replaces the second edition (ISO 11843-7:2018), which has been technically revised.

The main changes are as follows:

— a new subclause 7.3 was created;

— subclause 6.3 of the second edition was renumbered as Clause 8.

A list of all parts in the ISO 11843 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

The series of ISO 11843 is based on the probability distributions of the net state variable (measurand) for both the linear and nonlinear calibration situations. The focus is implicitly, though sometimes explicitly, on the uncertainty associated with an estimate of the measured response predominantly coming from the baseline noise in instrumental analysis. In many, if not most, analytical instruments, the baseline noise is considered the prime cause of uncertainty when the sample amount is as low as the minimum detectable value. Within its domain of applicability, the method given in this document can dispense with the repetition of real samples, thus helping to improve global environments by saving time and energy that would be required by repetition.

Background noise exists ubiquitously in analytical instruments, whether or not a sample is applied to the instrument. This document is concerned with mathematical methodologies for estimating the minimum detectable value in case that the most predominant source of measurement uncertainty is background noise. The minimum detectable value can directly and mathematically be derived from the stochastic characteristics of the background noise.

The basic concept of this document is the mathematical description of the probability distribution of the response variable in terms of mathematically well-defined random processes. This description straightforwardly leads to the minimum detectable value. As for the relation of the response and measurand, linear and nonlinear calibration functions can be applied. In this manner, compatibility with ISO 11843-2 and ISO 11843-5 is ensured.

The definition and applicability of the minimum detectable value are described in ISO 11843-1 and ISO 11843-2; the definition and applicability of the precision profile are described in ISO 11843-5. The precision profile expresses how the precision changes depending on the net state variable.

The minimum detectable value, x_d, is generally expressed in the unit of the net state variable. If the calibration function is linear, the standard deviation (SD) or coefficient of variation (CV) of the response variable estimated in this document can linearly be transformed to the SD or CV of the net state variable, which in turn can be used for the estimation of the minimum detectable value, x_d.

If the calibration function is nonlinear, the precision profile of the response variable in this document needs to be transformed to the precision profile of the net state variable as shown in ISO 11843-5. In this situation, the contents of ISO 11843-5 can be used for this purpose without modification.

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Capability of detection —

Part 7: Methodology based on stochastic properties of instrumental noise

1 Scope

This document specifies the practical use of the fundamental concepts in ISO 11843 in case of the background noise predominance in instrumental analysis.

This document specifies basic methods to

— extract the stochastic properties of the background noise,

— use the stochastic properties to estimate the SD or CV of the response variable, and

— calculate the minimum detectable value based on the SD or CV obtained above.

The methods described in this document are useful for checking the detection of a certain substance by various types of measurement equipment in which the background noise of the instrumental output predominates over the other sources of measurement uncertainty. Feasible choices are visible and ultraviolet absorption spectrometry, atomic absorption spectrometry, atomic fluorescence spectrometry, luminescence spectrometry, liquid chromatography and gas chromatography.

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 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*

ISO 3534-3, *Statistics — Vocabulary and symbols — Part 3: Design of experiments*

ISO 5725-1, *Accuracy (trueness and precision) of measurement methods and results — Part 1: General principles and definitions*

ISO 11843-1, *Capability of detection — Part 1: Terms and definitions*

ISO 11843-2, *Capability of detection — Part 2: Methodology in the linear calibration case*

ISO 11843-5, *Capability of detection — Part 5: Methodology in the linear and non-linear calibration cases*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 3534-1, ISO 3534-2, ISO 3534-3, ISO 5725-1, ISO 11843-1, ISO 11843-2, ISO 11843-5 and the following apply.

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