

BS ISO 11843-7:2012



BSI Standards Publication

Capability of detection

Part 7: Methodology based on stochastic properties of instrumental noise

NO COPYING WITHOUT BSI PERMISSION EXCEPT AS PERMITTED BY COPYRIGHT LAW

raising standards worldwide™

Full document details: BS ISO 11843-7:2012



National foreword

This British Standard is the UK implementation of ISO 11843-7:2012.

The UK participation in its preparation was entrusted to Technical Committee SS/6, Precision of test methods.

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

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

© The British Standards Institution 2012. Published by BSI Standards Limited 2012

ISBN 978 0 580 67951 3

ICS 03.120.30; 17.020

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 30 June 2012.

Amendments issued since publication

Date	Text affected
------	---------------

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*



Reference number
ISO 11843-7:2012(E)

AVA Documents
Document Sharing Hub
© ISO 2012



COPYRIGHT PROTECTED DOCUMENT

© ISO 2012

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

Foreword	iv
Introduction	v
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Quantitative analysis and background noise	2
4.1 Error sources of analysis	2
4.2 Random processes in background	3
5 Theories for precision	3
5.1 Theory based on auto-covariance function	3
5.2 Theory based on power spectrum	5
6 Practical use of FUMI theory	9
6.1 Estimation of noise parameters	9
6.2 Procedures for estimation of SD	10
Annex A (informative) Symbols and abbreviated terms used in this part of ISO 11843	13
Annex B (informative) Derivation of Formula (7)	14
Annex C (informative) Derivation of Formulae (14) to (16)	15
Bibliography	17

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 11843-7 was prepared by Technical Committee ISO/TC 69, *Application of statistical methods*, Subcommittee SC 6, *Measurement methods and results*.

ISO 11843 consists of the following parts, under the general title *Capability of detection*:

- *Part 1: Terms and definitions*
- *Part 2: Methodology in the linear calibration case*
- *Part 3: Methodology for determination of the critical value for the response variable when no calibration data are used*
- *Part 4: Methodology for comparing the minimum detectable value with a given value*
- *Part 5: Methodology in the linear and non-linear calibration cases*
- *Part 6: Methodology for the determination of the critical value and the minimum detectable value in Poisson distributed measurements by normal approximations*
- *Part 7: Methodology based on stochastic properties of instrumental noise*

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 part of ISO 11843 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.

The basic concept of ISO 11843-7 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. ISO 11843-7 specifies the practical use of the fundamental concepts in ISO 11843 in case of the background noise predominance in instrumental analysis.

The minimum detectable value, x_d , is generally expressed in the unit of the net state variable. If the calibration function is linear, the SD or CV of the response variable estimated in this part of ISO 11843 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 part of ISO 11843 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 the slightest modification.

Capability of detection —

Part 7:

Methodology based on stochastic properties of instrumental noise

1 Scope

Background noise exists ubiquitously in analytical instruments, whether or not a sample is applied to the instrument. This part of ISO 11843 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.

It specifies basic methods to

- extract the stochastic properties of the background noise,
- use the stochastic properties to estimate the standard deviation (SD) or coefficient of variation (CV) of the response variable, and
- calculate the minimum detectable value based on the SD or CV obtained above.

The methods described in this part of ISO 11843 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 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 11843-1:1997, *Capability of detection — Part 1: Terms and definitions*

ISO 11843-2:2000, *Capability of detection — Part 2: Methodology in the linear calibration case*

ISO 11843-5:2008, *Capability of detection — Part 5: Methodology in the linear and non-linear calibration cases*

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*

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. A list of symbols and abbreviated terms used in this document is provided in Annex A.