Toote geomeetrilised spetsifikatsioonid (GPS). Töödeldavate detailide ja mõõtevahendite kontrollimine mõõtmete alusel. Osa 2: Juhised mõõtemääramatuse arvutamiseks toote geomeetriliste spetsifikatsioonidega (GPS) seotud mõõtmistel, mõõtevahendite kalibreerimisel ja toodangu nõuetele vastavuse hindamisel

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ISO 14253-2:2011

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NATIONAL FOREWORD

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English Version

Geometrical product specifications (GPS) - Inspection by measurement of workpieces and measuring equipment - Part 2: Guidance for the estimation of uncertainty in GPS measurement, in calibration of measuring equipment and in product verification (ISO 14253-2:2011)

Spécification géométrique des produits (GPS) - Vérification par la mesure des pièces et des équipements de mesure - Partie 2: Lignes directrices pour l'estimation de l'incertitude dans les mesures GPS, dans l'étalonnage des équipements de mesure et dans la vérification des produits (ISO 14253-2:2011)

Geometrische Produktspezifikationen (GPS) - Prüfung von Werkstücken und Messgeräten durch Messen - Teil 2: Leitfaden zur Schätzung der Unsicherheit von GPS-Messungen bei der Kalibrierung von Messgeräten und bei der Produktprüfung (ISO 14253-2:2011)

This European Standard was approved by CEN on 14 April 2011.

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Ref. No. EN ISO 14253-2:2011: E

Foreword

This document (EN ISO 14253-2:2011) has been prepared by Technical Committee ISO/TC 213 "Dimensional and geometrical product specifications and verification" in collaboration with Technical Committee CEN/TC 290 “Dimensional and geometrical product specification and verification” the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by October 2011, and conflicting national standards shall be withdrawn at the latest by October 2011.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes ENV ISO 14253-2:2001.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

Endorsement notice

The text of ISO 14253-2:2011 has been approved by CEN as a EN ISO 14253-2:2011 without any modification.

Contents

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Introduction

This part of ISO 14253 is a global GPS standard (see ISO/TR 14638:1995). This global GPS standard influences chain links 4, 5 and 6 in all chains of standards.

The ISO/GPS Masterplan given in ISO/TR 14638 gives an overview of the ISO/GPS system of which this document is a part. The fundamental rules of ISO/GPS given in ISO 8015 apply to this document and the default decision rules given in ISO 14253-1 apply to specifications made in accordance with this document, unless otherwise indicated.

For more detailed information on the relation of this International Standard to other standards and to the GPS matrix model, see Annex D.

This part of ISO 14253 has been developed to support ISO 14253-1. This part of ISO 14253 establishes a simplified, iterative procedure of the concept and the way to evaluate and determine uncertainty (standard uncertainty and expanded uncertainty) of measurement, and the recommendations of the format to document and report the uncertainty of measurement information as given in the *Guide to the expression of uncertainty in measurement* (GUM). In most cases, only very limited resources are necessary to estimate uncertainty of measurement by this simplified, iterative procedure, but the procedure may lead to a slight overestimation of the uncertainty of measurement. If a more accurate estimation of the uncertainty of measurement is needed, the more elaborated procedures of the GUM need to be applied.

This simplified, iterative procedure of the GUM methods is intended for GPS measurements, but may be used in other areas of industrial (applied) metrology.

The uncertainty of measurement and the concept of handling uncertainty of measurement are important to all the technical functions within a company. This part of ISO 14253 is relevant to several technical functions, including management, design and development, manufacturing, quality assurance and metrology.

This part of ISO 14253 is of special importance in relation to ISO 9000 quality assurance systems, e.g. it is a requirement that methods for monitoring and measurement of the quality management system processes are suitable. The measurement uncertainty is a measure of the process suitability.

In this part of ISO 14253, the uncertainty of the result of a process of calibration and a process of measurement is handled in the same way:

— calibration is treated as a “measurement of the metrological characteristics of a measuring equipment or a measurement standard”;

— measurement is treated as a “measurement of the geometrical characteristics of a workpiece”.

Therefore, in most cases, no distinction is made in the text between measurement and calibration. The term “measurement” is used as a synonym for both.

Geometrical product specifications (GPS) — Inspection by measurement of workpieces and measuring equipment —

Part 2: Guidance for the estimation of uncertainty in GPS measurement, in calibration of measuring equipment and in product verification

1 Scope

This part of ISO 14253 gives guidance on the implementation of the concept of the "Guide to the estimation of uncertainty in measurement" (in short GUM) to be applied in industry for the calibration of (measurement) standards and measuring equipment in the field of GPS and the measurement of workpiece GPS characteristics. The aim is to promote full information on how to achieve uncertainty statements and provide the basis for international comparison of measurement results and their uncertainties (relationship between purchaser and supplier).

This part of ISO 14253 is intended to support ISO 14253-1. Both parts are beneficial to all technical functions in a company in the interpretation of GPS specifications [i.e. tolerances of workpiece characteristics and values of maximum permissible errors (MPEs) for metrological characteristics of measuring equipment].

This part of ISO 14253 introduces the Procedure for Uncertainty MAnagement (PUMA), which is a practical, iterative procedure based on the GUM for estimating uncertainty of measurement without changing the basic concepts of the GUM. It is intended to be used generally for estimating uncertainty of measurement and giving statements of uncertainty for:

— single measurement results;

— the comparison of two or more measurement results;

— the comparison of measurement results — from one or more workpieces or pieces of measurement equipment — with given specifications [i.e. maximum permissible errors (MPEs) for a metrological characteristic of a measurement instrument or measurement standard, and tolerance limits for a workpiece characteristic, etc.], for proving conformance or non-conformance with the specification.

The iterative method is based basically on an upper bound strategy, i.e. overestimation of the uncertainty at all levels, but the iterations control the amount of overestimation. Intentional overestimation — and not under-estimation — is necessary to prevent wrong decisions based on measurement results. The amount of overestimation is controlled by economical evaluation of the situation.

The iterative method is a tool to maximize profit and minimize cost in the metrological activities of a company. The iterative method/procedure is economically self-adjusting and is also a tool to change/reduce existing uncertainty in measurement with the aim of reducing cost in metrology (manufacture). The iterative method makes it possible to compromise between risk, effort and cost in uncertainty estimation and budgeting.

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 14253-1:1998, *Geometrical Product Specifications (GPS) — Inspection by measurement of workpieces and measuring equipment — Part 1: Decision rules for proving conformance or non-conformance with specifications*

ISO 14660-1:1999, *Geometrical Product Specifications (GPS) — Geometrical features — Part 1: General terms and definitions*

ISO/IEC Guide 98-3:2008, *Uncertainty of measurement — Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)*

ISO/IEC Guide 99:2007, *International vocabulary of metrology — Basic and general concepts and associated terms (VIM)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 14253-1, ISO 14660-1, ISO/IEC Guide 98-3 and ISO/IEC Guide 99 and the following apply.

3.1
black box model for uncertainty estimation
model for uncertainty estimation in which the uncertainties associated with the relevant input quantities are directly represented by their influence on the quantity value being attributed to a measurand (in the units of the measurand)

NOTE 1 The “quantity value being attributed to a measurand” is typically a measured value.

NOTE 2 In many cases, a complex method of measurement may be looked upon as one simple black box with stimulus in and result out from the black box. When a black box is opened, it may turn out to contain several “smaller” black boxes or several transparent boxes, or both.

NOTE 3 The method of uncertainty estimation remains a black box method even if it is necessary to make supplementary measurements to determine the values of influence quantities in order to make corresponding corrections.

3.2
transparent box model for uncertainty estimation
model for uncertainty estimation in which the relationship between the input quantities and the quantity value being attributed to a measurand is explicitly expressed with equations or algorithms

3.3
measuring task
quantification of a measurand according to its definition

3.4
overall measurement task
measurement task that quantifies the final measurand

3.5
intermediate measurement task
measurement task obtained by subdividing the overall measurement task into simpler parts

NOTE 1 The subdivision of the overall measuring task serves the goal of simplification of the evaluation of uncertainty.

NOTE 2 The specific subdivisions are arbitrary, as is whether to subdivide at all.