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

Part 3: Guidelines for achieving agreements on measurement uncertainty statements

Spécification géométrique des produits (GPS) — Vérification par la mesure des pièces et des équipements de mesure —

Partie 3: Lignes directrices pour l'obtention d'accords sur la déclaration des incertitudes de mesure

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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.

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 14253-3 was prepared by Technical Committee ISO/TC 213, *Dimensional and geometrical product specifications and verification*.

This first edition of ISO 14253-3 cancels and replaces ISO/TS 14253-3:2002, which has been technically revised.

ISO 14253 consists of the following parts, under the general title *Geometrical product specifications (GPS) — Inspection by measurement of workpieces and measuring equipment*:

— *Part 1: Decision rules for proving conformance or non-conformance with specifications*

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

— *Part 3: Guidelines for achieving agreements on measurement uncertainty statements*

— *Part 4: Background on functional limits and specification limits in decision rules* [Technical Specification]

Introduction

This part of ISO 14253 is a geometrical product specification (GPS) International Standard and is to be regarded as a global GPS Standard (see ISO/TR 14638). It influences links 4, 5 and 6 of all chains of standards in the general GPS matrix.

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

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

ISO 14253-1 provides decision rules for proving conformance or non-conformance with specifications of workpieces and measuring equipment when taking into account the uncertainty of measurement. ISO 14253-2 provides instructions for preparing uncertainty budgets for determining measurement uncertainty as defined in the *Guide to the Expression of Uncertainty in Measurement* (*GUM*). However, the possibility still exists that disagreement between customer and supplier can occur on the estimated measurement uncertainty.

It is becoming increasingly common for suppliers to have in place a quality system providing satisfactory assurance to the customer that the latter is receiving a product which conforms to specifications. This avoids the need for costly duplicate inspections.

For this reason, the most common case of disagreement over a measurement uncertainty statement or an uncertainty budget involves the customer questioning the supplier's uncertainty budget. The customer may also question the measured value of a characteristic of a workpiece or of measuring equipment, thus indirectly questioning the total uncertainty budget (see ISO 14253-1).

In a rarer case of disagreement, the supplier may question the customer's uncertainty budget when the customer rejects a workpiece or measuring equipment (see ISO 14253-1:1998, 6.2).

In addition to those mentioned, there are other cases of disagreement, as well as other motivations that may lead to discussion of stated uncertainties.

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

Part 3: Guidelines for achieving agreements on measurement uncertainty statements

1 Scope

This part of ISO 14253 provides guidelines and defines procedures for assisting the customer and supplier to reach amicable agreements on disputed measurement uncertainty statements regulated in accordance with ISO 14253-1, and so avoid costly and time-consuming disputes.

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 14253-2:2011, *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 14978:2006, *Geometrical product specifications (GPS) — General concepts and requirements for GPS measuring equipment*

ISO 17450-1:—[1], *Geometrical product specifications (GPS) — General concepts — Part 1: Model for geometrical specification and verification*

ISO 17450-2:—[2], *Geometrical product specifications (GPS) — General concepts — Part 2: Basic tenets, specifications, operators and uncertainties*

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)*

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1) To be published. (Revision of ISO/TS 17450-1:2005)

2) To be published. (Revision of ISO/TS 17450-2:2002)

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 14253-1, ISO 14253-2, ISO 14978, ISO 17450-1, ISO 17450-2, ISO/IEC Guide 98-3 and ISO/IEC Guide 99 apply.

4 Reaching an agreement on a stated expanded uncertainty

4.1 Early agreement on the stated measurement uncertainty

In a case where either the customer's or supplier's measurement uncertainty statement is in question, an uncertainty budget supporting and documenting the measurement uncertainty statement may be necessary. It is the responsibility of the party preparing the uncertainty budget to justify the individual components and the resulting estimated expanded uncertainty of the uncertainty budget.

In an ideal situation, customer and supplier will address the issue of measurement uncertainty at the same time as they address the product specifications of the workpiece, at the pre-contract stage. Agreement on the magnitude of the measurement uncertainty or uncertainties and the rules for its application at this early stage of the business relationship will avoid later disputes over acceptance or rejection of product and the consequent need to apply the default rules given in ISO 14253-1.

NOTE In most cases, there are several GPS characteristics specified for a workpiece and for each of these characteristics a measuring task with corresponding measurement uncertainty statement is required.

Two different persons can produce two different uncertainty statements due to differing knowledge, experience and assumptions. Resolving these differences at the pre-contract stage is likely to be less contentious and less costly than waiting until an argument develops over the acceptance or rejection of the product during the manufacture and delivery stage.

4.2 Possibilities for solving disagreements over a stated measurement uncertainty

The most basic way of reaching an agreement is to agree to choose one of the two statements of measurement uncertainty from either party to the agreement. If this type of settlement is not appropriate, another solution is to use the more refined procedure given in Clause 5, or to use a third party consultation or a review or both.

Clause 6 of ISO 14253-1:1998 gives specific rules on dealing with uncertainty of measurement when proving conformance or non-conformance with a specification:

— supplier proving conformance with specifications (ISO 14253-1:1998, 6.2);

— customer proving non-conformance with specifications (ISO 14253-1:1998, 6.3).

The magnitude of the measurement uncertainty is of importance, because it decreases the conformance zone (supplier proving conformance) and the non-conformance zone (customer proving non-conformance).

NOTE 1 Decreasing the non-conformance zone increases the interval where non-conformance cannot be proven. According to ISO 14253-1, the measurement uncertainty is stated by the party providing the proof of conformance or non-conformance with a specification, i.e. the party making the measurements. In the following clauses of this part of ISO 14253, the party stating the measurement uncertainty is designated “party 1”. The other of the two parties is designated “party 2”. “Party 2” is the party likely to question or disagree with the stated measurement uncertainty.

NOTE 2 When the supplier is proving conformance with specification, the supplier is “party 1” and it is the customer, “party 2”, who provides the specification. When the customer is proving non-conformance, the customer is “party 1” and is also considered to have provided the specification, hence it is the supplier who is “party 2”.

A number of scenarios can be demonstrated for cases where a stated measurement uncertainty from "party 1" may be questioned by "party 2". Figure 1 illustrates the most common scenarios, as follows.

a) A measurement uncertainty is stated by "party 1" (**box a**).

b) "Party 2" has two options (**box b**).

   1) If "party 2" agrees to the measurement uncertainty statement (**box b — "Yes"**), both parties have come to the same conclusion. The issue is resolved (**box z**).

      NOTE A measurement uncertainty statement can be a simple claimed value without any documentation or an uncertainty budget with a resulting expanded uncertainty according to ISO 14253-2.

   2) If "party 2" disagrees with the measurement uncertainty statement (**box b — "No"**), this part of ISO 14253 applies.

c) The two parties may use a third party to resolve their disagreement.

   1) If yes (**box c — "Yes"**), the third party will evaluate the uncertainty budget (**box v**). The issue is resolved (**box z**).

   2) If no (**box c — "No"**), the two parties continue with the procedure (**box d**).

d) "Party 1" may or may not have generated an uncertainty budget according to ISO 14253-2 (**box d**).

   1) If an uncertainty budget does not exist (**box d — "No"**), there are two options.

      i) The two parties agree, by decision, and without further documentation, on a "new" measurement uncertainty statement (**box e — "Yes"**). In this case, "party 1" shall change the uncertainty statement according to the agreement (**box f**), and the issue is resolved (**box z**).

      ii) "Party 2" requires an uncertainty budget from "party 1" (**box e — "No"**). "Party 1" then has two options.

         I) Use a third party (**box g — "Yes"**). The third party shall evaluate the uncertainty budget (**box v**). The issue is resolved (**box z**).

         II) Do not use third party (**box g — "No"**). "Party 1" shall generate an uncertainty budget (**box h**) according to the guidelines given in ISO 14253-2 (**box j**). When the uncertainty budget is prepared, the procedure recommences from the starting point (**box a**).

   2) If the uncertainty budget exists (**box d — "Yes"**), proceed to the next option.

e) The uncertainty budget prepared by "party 1" may or may not be known to "party 2" at this moment (**box k**).

   1) If the uncertainty budget exists, but only the measurement uncertainty has been reported to "party 2" (**box k — "No"**), "party 1" shall make the uncertainty budget and the inherent documentation known to "party 2" (**box m**). The procedure then recommences from the starting point (**box a**).

   2) If the uncertainty budget is known to "party 2", the following situations arise (**box k — "Yes"**).

f) The two parties either will or will not come to an immediate agreement based on the presented uncertainty budget and without making further detailed investigations (**box n**).

   1) The two parties can, by decision, and without further documentation, agree on the stated or a "new" measurement uncertainty statement (**box n — "Yes"**). In the case of a "new" uncertainty statement, "party 1" shall change the uncertainty budget and the uncertainty statement according to the agreement (**box o**), thus resolving the issue (**box z**).

   2) If the two parties cannot agree immediately on the presented uncertainty budget (**box n — "No"**), the approach will depend on the level of the uncertainty budget at which they disagree.

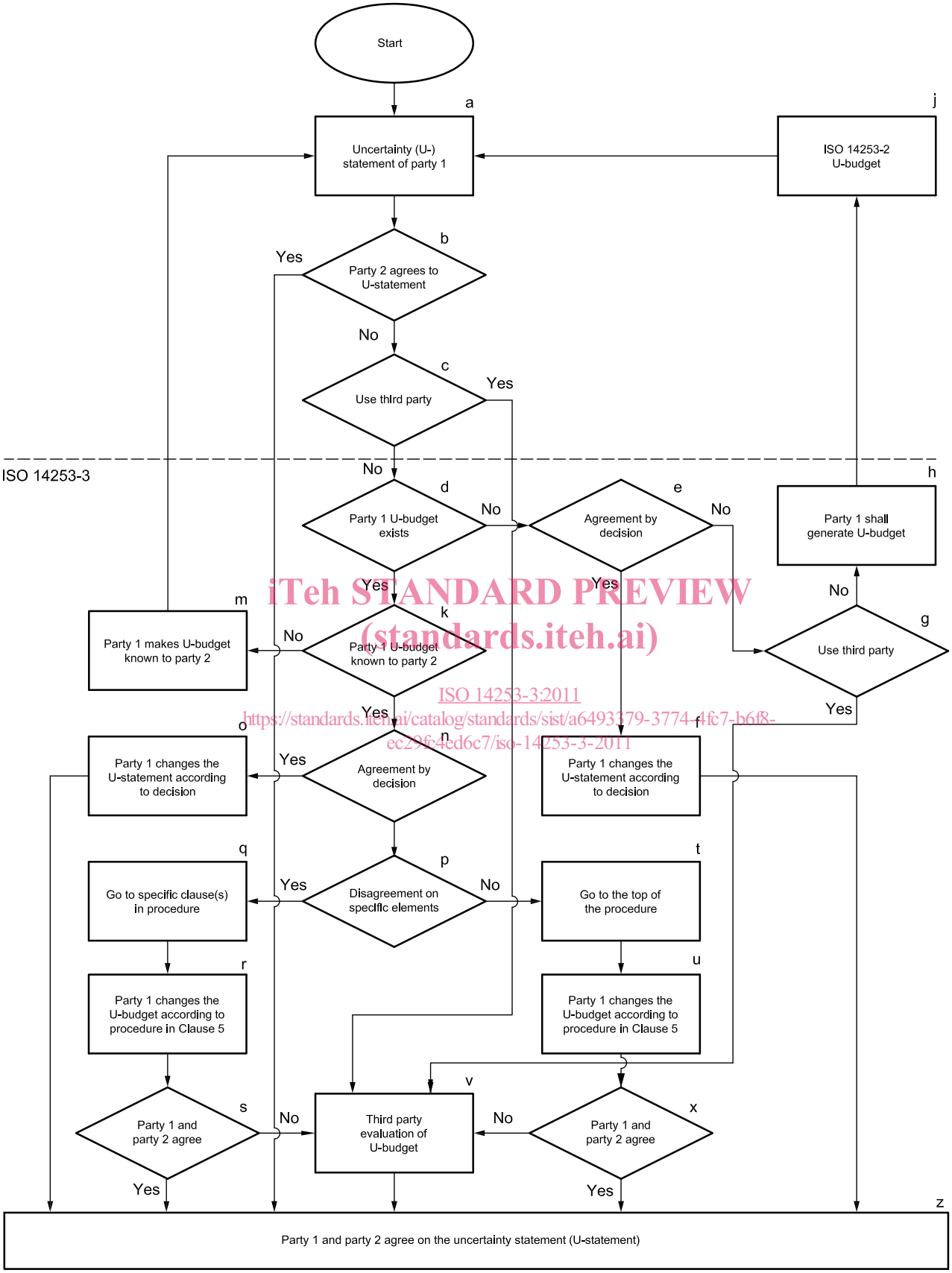

Figure 1 — How to agree on an uncertainty statement

g) Disagreement on the presented uncertainty budget or measurement uncertainty or both could be limited to specific components in the uncertainty budget, or it could be a general disagreement (**box p**).

   1) If the disagreement concerns only specific and identifiable components of the uncertainty budget and its preconditions, it is possible (**box q**) to re-evaluate, and work directly on, the elements in the procedure described in Clause 5. "Party 1" shall modify the uncertainty budget or preconditions or both, as well as the resulting uncertainty statement (**box r**), according to common agreement.

      i) The result may not be acceptable to one of the parties (**box s — "No"**). The possibility of an amicable solution remains, by means of third party evaluation (**box v**), and the issue is resolved (**box z**).

      ii) If the result of the modification in the uncertainty budget is acceptable to both parties (**box s — "Yes"**), the issue is resolved (**box z**).

   2) If the disagreement on the uncertainty budget and its preconditions is of a general character, the solution is to proceed to the starting point of the procedure given in Clause 5 (**box t**). "Party 1" shall modify the uncertainty budget or preconditions or both, as well as the resulting uncertainty statement (**box u**).

      i) The result may not be acceptable to one of the parties (**box x — "No"**). Use third party evaluation of the uncertainty budget (**box v**). The issue is resolved (**box z**).

      ii) If the result of the modification in the uncertainty budget is acceptable to both parties (**box x — "Yes"**), the issue is resolved (**box z**).

5 Sequential procedure for evaluating and reaching agreement on an uncertainty statement

5.1 General

The basis and documentation of an uncertainty statement are the uncertainty budget together with its defined preconditions (see ISO 14253-2:2011, 9.2). The basis for an agreement on an uncertainty statement is the agreement on the uncertainty budget together with the preconditions of that budget.

In simple cases, and if experience exists, the uncertainty statement may be accepted and agreed to by both parties without the documentation of a specific uncertainty budget.

To reach common agreement on the uncertainty statement in more complex cases, the sequence of activities/stages (see Figure 2, 1 to 11) in an uncertainty budgeting process (given in 5.2 to 5.12) shall be executed in the mentioned order. Agreement shall be reached clause by clause in order to establish, from the outset, the argumentation and proof for the uncertainty as the agreed prerequisites.

If any major modification is made at any stage in the sequence, it is essential that the modification be sequentially applied right through to the final statement of expanded uncertainty, U, in order to see the effect on the function of the product and its impact on any possible agreement.

Details of the uncertainty estimation and its necessary budgeting referred to in the following subclauses are given in ISO 14253-2. References to the relevant clauses in ISO 14253-2 are given as follows.