

Interim Applications

(May 7, 2009)

Requirements Document: ISO Guide 34:2000

Clause: 5.15.1

Question: What are the requirements for the statements of uncertainty of assigned values for certified reference materials (CRMs)?

Response:

Uncertainty for the Assigned Values for Certified Reference Materials

This application is issued as a clarification of A2LA's policies on implementation of the requirements of ISO Guide 34 for the accreditation of Reference Material Producers, particularly for the production of Certified Reference Materials. A2LA assessors will be assessing all requirements of ISO Guide 34, including ISO Guides 31 and 35, as they have in the past. However due to the obligations of our Mutual Recognition Arrangement within the Asia Pacific Laboratory Accreditation Cooperation (APLAC), we are enforcing some requirements more strictly than may have been the practice in the past.

Specifically, our assessors will be focusing their attention on the requirements included on page 2 below regarding the statements of uncertainty of Assigned Values. ISO Guide 34, 35 and 31 requirements are very clear that uncertainty statements are to include estimates of the homogeneity and stability of the finished products. Estimates of uncertainty shall include bottle-to bottle variability as determined by testing and statements, or estimates of short term and long term stability, including the effects of time, temperature, moisture, and light. Short term stability estimates must also consider any anticipated effects of transport.

There are two caveats associated with these requirements:

1. If the reference material producer can demonstrate (with technical justification backed by test or measurement data) that any of these effects are sufficiently small that they can be ignored (per the GUM), then the statements of uncertainty need not include those components.
2. For routinely produced materials, such as calibration materials, where the component materials, levels, and processes are consistent across lots of production, the producer may provide a thorough characterization of one lot of reference material, and then verify that the estimates of uncertainty are met by each subsequent lot (that is, that each lot is equivalent). It is expected that full characterization will occur for every new design of a reference material. However, if new reference materials have changes to the formulation or production process that do not impact the estimates of uncertainty, then re-characterization is not necessary. The verification procedure

must be documented and included in the product design. If batches are verified rather than fully characterized, procedures must include criteria for acceptance of equivalence of batches, and for determining that different production designs have equivalent uncertainty.

A2LA recognizes that these requirements can be difficult to fully implement, but we are in agreement with the ISO Reference Material Committee, (REMCO), that they are important components of reliable uncertainty statements.

Please note that in cases where deficiencies are cited to this subject matter and clauses identified in this application, A2LA will permit a departure from our normal policies, by permitting all new and renewal reference material producers to have up to one year, from the date of the approval of this Application by the A2LA Criteria Council address these requirements.

The following paragraphs emphasize several of the specific requirements from the ISO Standards and are provided to the Criteria Council verbatim for review. Due to copyright restrictions only the clause designation and subject will be included for the web site application.

ISO Guide 34 Requirements:

- 5.8.2** The reference material producer shall be able to demonstrate that the candidate reference material is sufficiently homogeneous; i.e. the difference, if any, between units shall be smaller than the uncertainty limits stated in the certificate.
- 5.9.1** Where appropriate, the reference material producer shall carry out an assessment of the homogeneity of any candidate reference material by analyzing a representative number of randomly, systematically or stratified randomly chosen units. This should be done by means of a measurement method, the repeatability of which is fit for the purpose required (i.e. good enough to not contribute significantly to the combined uncertainty). The assessment procedure shall be documented and conducted in accordance with acceptable statistical procedures.
- 5.15.1** In assigning uncertainties to the property values of interest, any uncertainties resulting from between-unit variations and/or from possible instabilities (both during storage and during transportation) shall be included.

Please note, ISO Guide 34 sections 5.14 Characterization and 2 Normative references, consider ISO Guide 35 as a normative reference (that is, all requirements apply):

5.14 Characterization

The reference material producer shall use and document technically valid procedures to characterize its reference materials. Where possible, the characterization should comply with the requirements of ISO Guide 35.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this Guide...

ISO Guide 31:1981, Contents of certificates or reference materials

ISO Guide 35:2006, Certification of reference materials — General and statistical principles.

The following paragraphs emphasize several of the specific requirements from ISO Guide 35. The copyright restrictions also apply to these paragraphs.

ISO Guide 35 Requirements:

6.2 Basic model for a batch characterization

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Modelling a characterization process for the evaluation of uncertainty is neither a routine task nor a strictly mathematical one. The establishment of a proper model for a property value of a specific candidate CRM is a complex task, which should be carried out with great care to account for all relevant details of the procedures followed to produce and certify the material. One of the basic requirements of the model is that all factors are included that could significantly contribute to the uncertainty associated with the property values of the CRM.

Therefore, in order to be complete, the combined standard uncertainty on a reference material, *the reference material producer* should acknowledge that homogeneity and both long- and short-term stability also play an important role in addition to the characterization of the batch. Therefore, the uncertainty of a reference material can be expressed as follows:

- a) uncertainty of the certified value as obtained for the batch (characterization);
- b) transferred to a single package (homogeneity);
- c) as dispatched to the customer (short-term stability);
- d) at the time of sale (long-term stability).

This definition of the uncertainty associated with a property value of a CRM considers the following factors:

- e) the (thorough) characterization of the material is accompanied by an uncertainty;
- f) the user will (as a rule) use only one sample at a time;
- g) the material will be stored for a longer period of time by the producer/seller;
- h) the material must be transported to the user.

These factors could all significantly contribute to the uncertainty associated with the value assigned to the measurand (i.e. the value to be certified) for a CRM. Appreciation of these influencing factors does not go any further than regular operations. Uncertainty evaluation is not intended, and should not be used, to account for accidents, mistakes, improper use, improper transport, etc., of the CRM. This approach is in agreement with GUM:1993, 3.4.8.

5.8 Homogeneity study

A homogeneity study is necessary in batch certification projects to demonstrate that the batch of bottles (units) is sufficiently homogeneous. Aspects of quality assurance are as important as the determination of the remaining batch between-bottle variation, which is an uncertainty component to be included in the uncertainty estimate of the property value of the CRM. Even when a material is expected to be homogeneous, as in the case of solutions, an assessment of the between-bottle inhomogeneity is required. When dealing with solidstate reference materials, including slurries and sludges, a within-bottle homogeneity study should be foreseen to determine the minimum sample intake. In principle, this homogeneity study does not add to the uncertainty of the property value in question. The number of extra samples needed mainly depends on the between-bottle homogeneity study. The minimum number of bottles selected at random is between 10 and 30, but should generally not be smaller than 10.

5.10 Finally, the measurements of the homogeneity study, stability study and the characterization of the material should be combined in order to obtain a proper estimate for the property value and its standard uncertainty.

5.12 Summary of project design

In summary, the following steps have been identified for emphasis, for the preparation of reference material:

...1) combination of the results from homogeneity testing, stability testing and characterization, including a full evaluation of measurement uncertainty;

6.2 Assuming independence of the variables, the uncertainty associated with a property value of a CRM can be expressed as

$$u_{\text{CRM}} = \sqrt{(u_{\text{char}}^2 + u_{\text{bb}}^2 + u_{\text{lts}}^2 + u_{\text{sts}}^2)} \quad (2)$$

using the error propagation formula in GUM:1993, E.8, the uncertainty components u_{bb} (between-bottle standard uncertainty), u_{lts} (long-term stability standard uncertainty) and u_{sts} (short-term stability standard uncertainty) correspond to the error terms in the model. The combined standard uncertainty associated with the property value of the CRM may be related to the shelf life of the material (see ISO Guide 35 Clause 8).

8.1 For the validity of the uncertainty stated on the certificate of a CRM, a correct estimation of the effects due to both long-term stability and short-term stability are as important as the correct assessment of the batch inhomogeneity (see ISO Guide 35, Clause 7). During the lifetime of the CRM, the validity of the uncertainty on the certificate should be demonstrable, so that the CRM can meet the requirements with regard to stability.

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