GLOBAL LABORATORIES ACCREDITATION BOARD

MEASUREMENT UNCERTAINTY

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1. Scope

1.1. This document explains on the measurement uncertainty policy that GLAB follows and pre requisites for a conformity assessment body

2. Introduction

2.1. The document defines the responsibilities of organizations seeking accreditation by GLAB with regard to the estimation of CMC (Calibration and Measurement Capability) and measurement uncertainty. The requirement to estimate CMC applies to calibration organizations only. This policy is based on the requirements outlined in ISO/IEC 17025:2017 and ISO/IEC 17011:2004, applies only to calibrations or tests for which an accredited result is to be reported.

2.2. The calculation of uncertainty for a measurement is an effort to set reasonable bounds for the measurement result according to standardized rules. These rules are established in the GUM (ISO/IEC Guide 98:1995 The Guide to the Expression of Uncertainty in Measurement).

2.3. The calculation of CMC is an effort to express "The smallest uncertainty which an organization can attain when performing a more or less routine calibration of a nearly ideal device under nearly ideal conditions". The CMC is a "special case" of uncertainty estimated for the "best existing device" within a calibration discipline or sub-discipline. By its nature it is the lower limit of uncertainty of measurement. It represents a theoretical uncertainty value the organization may approach when performing calibrations but never actually reach. By definition the organization can never perform a calibration for which the uncertainty is less than their stated CMC.

2.4. For testing organizations the rigorous, mathematically, and statistically valid estimate of the measurement uncertainty may not be possible. In such cases the organization must identify all the components of uncertainty and make a "reasonable estimation", The "reasonable estimation" is to be based on knowledge of the performance of the method and

on the measurement. It also shall make use of, for example, previous experience and validation data. This is especially applicable in the biological, chemical, environmental and sensory evaluation fields. The estimation can be based on standards or methods using verification or quality control data. Also, in those cases where a well-recognized test method specifies limits to the values of the major sources of uncertainty of measurement and specifies the form of presentation of calculated results, the laboratory is considered to have satisfied this clause by following the test method and reporting instructions.

3. Terminologies

3.1. **Uncertainty of measurements**

Reasonable bounds for the measurement result according to standardized rules. These rules are established in the GUM (ISO/IEC Guide 98:2008 The Guide to the Expression of Uncertainty in Measurement).

3.2. **Calibration and Measurement capability (CMC)**

CMC is defined as 'the smallest uncertainty which an organization can attain when performing a more or less routine calibration of a nearly ideal device under nearly ideal conditions'. The CMC is a "special case" of uncertainty estimated for the "best existing device" within a calibration discipline or sub-discipline. By its nature it is the lower limit of uncertainty of measurement. It represents a theoretical uncertainty value the organization may approach when performing calibrations but never actually reach.

3.3. **Measurand**

Particular quantity subject to measurement

3.4. **Scope Uncertainty**

The smallest uncertainty of measurement a laboratory can achieve as described within its scope of accreditation, when performing more or less routine calibrations of nearly ideal measurement standards intended to define, realize, conserve, or reproduce a unit of that quantity or one or more of its values, or when performing more or less routine calibrations

of nearly ideal measuring instruments (or best existing device) designed for the measurement of that quantity.

3.5. **Test uncertainty**

Represents the uncertainty of the test without consideration of any contributor associated with a unit under test (i.e., UUT resolution, short term repeatability of the UUT, environmental influences associated only with the UUT). A test uncertainty is used only to determine a test uncertainty ratio and is never reported as a measurement uncertainty.

3.6. **Test uncertainty ratio (TUR)**

The ratio of the span of the tolerance of a measurement quantity subject to calibration, to twice the 95% expanded uncertainty of the measurement process used for calibration.

4. Policy

4.1. The applicant calibration organization shall have and shall apply a documented procedure for estimating CMC and uncertainty of measurement. The organization must estimate the CMC for every measured quantity, instrument listed in its desired scope of accreditation in accordance with its documented procedure.

4.2. The applicant testing organization shall have and shall apply a documented procedure for estimating uncertainty of measurement for the tests it performs.

4.3. These procedures shall identify all sources of uncertainty, identify the manner in which the source is distributed and make a reasonable estimation of the contribution of each identified source. The organization must define the method by which it classifies sources as significant or insignificant. The organization shall then prepare an uncertainty budget containing all relevant information related to the identified significant sources of uncertainty. The budget shall be used to process the information it contains in a mathematically and statistically appropriate method producing as output the expanded uncertainty of measurement for the calibration or test performed. The coverage factor (k) and the confidence level must be stated as components of the output from the uncertainty budget. In addition, the budget shall be organized in such a way and contain sufficient

annotation to easily permit independent review and analysis during assessment or at other times as requested.

4.4. When using the uncertainty budget to estimate CMC for inclusion on its desired scope of accreditation, the calibration organization shall consider the performance of the "best existing device" available for each calibration sub-discipline. This means that for sources which can be expected to vary from calibration to calibration, identify the smallest contribution, which will occur when the conditions, which cause it, are at optimum and use these values in the estimate of CMC. For sources, which by their nature remain constant, the organization may use the smallest values they may reasonably expect to encounter.

4.5. Testing organizations performing their own calibrations shall use the appropriate uncertainty budget to estimate uncertainty of measurement for all calibrations performed. The values assigned for identified sources of uncertainty shall be those that apply to the specific unit under test, the equipment used to perform the calibration, environmental and environmental related conditions and personal influences as they exist at the time the calibration is performed.

4.6. Sources of uncertainty will include but not be limited to those items listed below:

4.6.1. Reference standards or reference materials

4.6.2. Methods and equipment used

4.6.3. Environmental conditions

4.6.4. Properties and condition of the unit under test

4.6.5. Operator

4.7. In those cases where a well recognized test method specifies limits to the values of the major sources of uncertainty of measurement and specifies the form of presentation of calculated results, the organization is considered to have satisfied ISO/IEC 17025:2017 by following the test method and reporting instructions.

4.8. When CMC is expressed as a Relative Uncertainty Equation it is permissible to employ a greater number of significant digits to preserve accuracy during computation of specific

CMC values. This is done with the understanding that when the equation is solved for specific values of the variable, the solution will be reduced to not more than 2 significant digits prior to recording the result. The number of significant digits to be used in CMC expressions resulting from conversion shall be no greater than that which produces a stated value that will, upon conversion back to the original system of units and rounded appropriately, generate the original value.

5. Maintaining Uncertainty

5.1. Upon achieving accreditation, the uncertainty budgets and the decisions regarding sources of uncertainty shall be periodically reviewed and updated by the organization to reflect changes in the organization, its equipment, procedures or personnel that might influence the ability of the organization to perform specific calibrations or tests for which they are accredited. These changes shall be documented. Additionally for calibration organizations, CMC's shall be recalculated based on any changes to the related uncertainty budgets or the underlying information contained within them. This information must be provided to the GLAB assessor during subsequent surveillance and reaccreditation assessments or to GLAB staff upon request. The process of review established by the organization must take into account all initially identified sources of uncertainty as well as any additional sources that might result from the potential changes mentioned above.

5.2. Any additions to an existing scope of accreditation will not be made until the previously stated requirements are fulfilled with regard to a documented procedure for estimation of uncertainty of measurement and CMC (for calibration organizations). This procedure and (for calibration organizations) the estimated CMC produced from it shall be made available to the GLAB assessor or to GLAB staff upon request. Upon review, the organization's procedure must be found to be reasonable and the calibration organization's CMC estimated from its use must be a reasonable value. If the CMC is stated as a relative value, then the results obtained from solving the relationship for any value between the minimum and maximum must be determined to be reasonable as well.

5.3. The combined and expanded uncertainties and the CMC (for calibration organizations) must be meaningful for any item that the organization intends to list on the scope of accreditation. GLAB reserves the right to reject any CMC or uncertainty estimates proposed by applicant or accredited organizations if in the opinion of GLAB the magnitude or the manner of estimation is not meaningful or appropriate. GLAB will initiate its policy for removal of the affected calibration or test activity from the scope of accreditation of the organization involved. The organization has the right to dispute this decision as outlined in GLAB's Dispute and Appeal Procedure.

5.4. ISO/IEC 17025:2017 establishes three options which apply to calibration organizations when reporting the results of calibrations performed. These reporting options are as follows:

5.4.1. The measurement result and its associated uncertainty of measurement.

5.4.2. The measurement result and a statement of compliance.

5.4.3. The measurement result, its associated uncertainty of measurement and a statement of compliance with an identified metrological specification or clauses thereof.

5.5. When making the statement that the measurement is in compliance with an “identified metrological traceability” the calibration organization is required per ISO/IEC17025:2017 (clause 7.8.6.2) to have accounted for the associated uncertainty of measurement in reaching its decision. Clause 7.8.6 of the standard describes the requirement that calibration and testing laboratories have and apply a procedure defining the manner by which they estimate the uncertainty of measurement for calibrations and test performed. Additionally for calibration laboratories, GLAB requires that this procedure also defines how the uncertainty is accounted for when making a statement of compliance with a specification.

5.6. In the instances when it is necessary for testing organizations to make “a statement of compliance / non-compliance with requirements and/or specifications” or “a statement on the estimated uncertainty of measurement” as detailed in ISO/IEC 17025:2017, clause 7.8.3.1 b) and c).

5.7. ISO/IEC 17025:2017 (clause 7.8.1) provides for calibration and test results to be reported. Simplified reporting to external customers is only permitted when authorized by the customer by means of a written agreement to that effect.

5.8. In the event that a written agreement exists between the organization and its customer instructing the organization to report only the measurement result, GLAB requires that the organization include a statement on the certificate issued indicating that the uncertainty of measurement associated with the measurement result contained in the calibration certificate (or test report when it is appropriate to do so) is available from the organization upon request.

5.9. In the event that a written agreement exists between the organization and it customer instructing the organization to report only the measurement result and a statement of compliance with an identified metrological traceability, GLAB requires that the organization include a statement on the certificate issued indicating that the uncertainty of measurement associated with the measurement result contained in the calibration certificate is available from the organization upon request. Additionally the statement must indicate that the uncertainty of measurement was accounted for in making the decision that the calibrated device was or was not in compliance.

6. References

6.1. ILAC P14:01/2013 ILAC Policy for Uncertainty in Calibration

6.2. ISO/IEC 17025:2017 General requirements for the competence of testing and calibration laboratories