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Policy

PL -34

SNAS POLICY FOR UNCERTAINTY IN CALIBRATION

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PURPOSE:

This document determines the SNAS Policy for uncertainty in calibration. This policy is an implementation of ILAC-P14:01/2013 document.

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1 INTRODUCTION

This document specifies the SNAS policy related to the estimation and determination of uncertainty in calibration and measurement in accredited calibration laboratories and reference material producers, consistent evaluation and application of calibration and measurement capability (CMC) and reporting the uncertainty in calibration and measurement certificates.

Specific advice on the evaluation of uncertainty can be found in the “Guide to the Expression of Uncertainty in Measurement” (GUM), first published in 1993 in the name of BIPM, IEC, IFCC, ISO, IUPAC, IUPAP and OIML. The GUM establishes general rules for evaluating and expressing uncertainty in measurement that can be followed in most fields of physical measurements. The GUM describes an unambiguous and harmonised way of evaluating and stating the uncertainty of measurement and provides several options to estimate and state uncertainty of measurement. Similarly, ISO Guide 35 provides specific advice on determining the contributions to uncertainty from reference materials, including instability, inhomogeneity, and sample size, but several options are allowed. This may result in various interpretations of the GUM and ISO Guide 35, and hence calibration/reference measurement laboratory and accredited reference material producers may report uncertainty of measurement in an inconsistent way.

Principles set out in this document apply to accredited calibration laboratories and accredited producers of reference materials providing services in the field of calibration and measurement.

Relevant sections of this policy may also be applicable to testing laboratories that perform their own calibrations.

2 TERMS AND DEFINITIONS

For the purpose of this document, the relevant terms and definitions given in the “International Vocabulary of Metrology – Basic and General Concepts and Associated Terms” (VIM) and the following terms and definitions apply:

Calibration Laboratory
In this policy, "calibration laboratory" further means a laboratory that provides calibration and measurement services.

Calibration and Measurement Capability
A CMC is a calibration and measurement capability available to customers under normal conditions:

- as described in the given laboratory's scope of accreditation or
- as published information in the BIPM key comparison database (KCDB) of the CIPM MRA

4 POLICY

4.1 SNAS Policy on the Estimation of Uncertainty of Measurement

SNAS requires the accredited calibration laboratories to estimate uncertainties of measurement for all calibrations and measurements covered by the scope of accreditation.

Accredited Calibration laboratories shall estimate uncertainties of measurement in compliance with the "Guide to the Expression of Uncertainty in Measurement" (GUM), including its supplement documents and/or ISO Guide 35. SNAS published MSA-L/12, which aims to harmonize the evaluation of measurement uncertainty and which is in accordance with the GUM.

4.2 SNAS Policy on Scope of Accreditation of Calibration Laboratories

The scope of accreditation of an accredited calibration laboratory (see MSA-L01) shall include the calibration and measurement capability (CMC) expressed in terms of:

- measurand or reference material,
- calibration/measurement method/procedure and/or type of calibrated/measured instrument/material,
- measurement range and additional parameters where applicable, e.g.,frequency of applied voltage,
- uncertainty of measurement

There shall be no ambiguity on the expression of the CMC on the scopes of accreditation and, consequently, on the smallest uncertainty of measurement that can be expected to be achieved by a laboratory during a calibration or a measurement. The uncertainty can be express:

- a single value, which is valid throughout the measurement range,
- a range; in this case the interpolation is necessary to be defined to find the uncertainty at intermediate values,
- an explicit function of the measurand or a parameter,
- a matrix where the <u>value</u> of the uncertainty depend on the <u>value</u> of the measurand and additional parameters,
- a graphical form, providing there is sufficient resolution on each axis to obtain at least two significant figures for the uncertainty.

Open intervals (e.g., "$U < x$") are not allowed in the specification of uncertainties.

The uncertainty covered by the CMC shall be expressed as the expanded uncertainty having a specific coverage probability of approximately 95 %. The unit of the uncertainty shall always be the same as that of the measurand or in a term relative to the measurand, e.g., percent.

Calibration laboratories shall provide evidence that they can provide calibrations to customers in compliance with information listed in the scope of accreditation so that measurement uncertainties equal those covered by the CMC. In the formulation of CMC, laboratories shall take into account the properties of the “best existing device” which is available for a specific category of calibrations.

A reasonable amount of contribution to uncertainty from repeatability shall be included and contributions due to reproducibility should be included in the CMC. There should, on the other hand, be no significant contribution to the CMC uncertainty component attributable to physical effects that can be ascribed to imperfections of even the best existing device under calibration or measurement.

It is recognized that for some calibrations a “best existing device” does not exist and/or contributions to the uncertainty attributed to the device significantly affect the uncertainty. If such contributions to uncertainty from the device can be separated from other contributions, then the contributions from the device may be excluded from the CMC statement. For such a case, however, the scope of accreditation shall clearly identify that the contributions to the uncertainty from the device are not included.

NOTE: The term “best existing device” is understood as a device to be calibrated that is commercially or otherwise available for customers, even if it has a special performance (stability) or has a long history of calibration.

Where laboratories provide services such as reference value provision, the uncertainty covered by the CMC should generally include factors related to the measurement procedure as it will be carried out on a sample, i.e., typical matrix effects, interferences, etc. shall be considered. The uncertainty covered by the CMC will not generally include contributions arising from the instability or inhomogeneity of the material. The CMC should be based on an analysis of the inherent performance of the method for typical stable and homogeneous samples.

NOTE: The uncertainty covered by the CMC for the reference value measurement is not identical with the uncertainty associated with a reference material provided by a reference materials producer. The expanded uncertainty of a certified reference material will in general be higher than the uncertainty covered by the CMC of the reference measurement on the reference material.

4.3 SNAS Policy on Statement of Uncertainty of Measurement on Calibration Certificates

Accredited calibration laboratories shall report the measured quantity value and the uncertainty of measurement, in compliance with the requirements listed further.

By exception, and where it has been established during contract review that only a statement of compliance with a specification is required, then the measured quantity value and the measurement uncertainty may be omitted on the calibration certificate. The following shall however apply:

- the calibration certificate is not intended to be used in support of the further dissemination of metrological traceability (i.e. to calibrate another device),
- the laboratory shall determine the uncertainty and take that uncertainty into account when issuing the statement of compliance,
- the laboratory shall retain documentary evidence of the measured quantity value and the uncertainty of measurement and shall provide such evidence upon request.

The measurement result shall normally include the measured quantity value y and the associated expanded uncertainty U. In calibration certificates the measurement result should be reported as $y \pm U$ associated with the units of y and U. Tabular presentation of the measurement result may be used and the relative expanded uncertainty $U / |y|$ may also be provided if appropriate. The coverage factor and the coverage probability shall be stated on the calibration certificate. To this an explanatory note shall be added, which may have the following content:

> “The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k such that the coverage probability corresponds to approximately 95 %.”

NOTE: For asymmetrical uncertainties other presentations than y ± U may be needed. This concerns also cases when uncertainty is determined by Monte Carlo simulations (propagation of distributions) or with logarithmic units.

The numerical value of the expanded uncertainty shall be given to, at most, two significant figures. Further the following applies:

- the numerical value of the measurement result shall in the final statement be rounded to the least significant figure in the value of the expanded uncertainty assigned to the measurement result.
- for the process of rounding, the usual rules for rounding of numbers shall be used, subject to the guidance on rounding provided i.e in Section 7 of the GUM.

NOTE: For further details on rounding, see ISO 80000-1:2009.

Contributions to the uncertainty stated on the calibration certificate shall include relevant short-term contributions during calibration and contributions that can reasonably be attributed to the customer's device. Where applicable the uncertainty shall cover the same contributions to uncertainty that were included in evaluation of the CMC uncertainty component, except that uncertainty components evaluated for the best existing device shall be replaced with those of the customer's device. Therefore, reported uncertainties tend to be larger than the uncertainty covered by the CMC. Random contributions that cannot be known by the laboratory, such as transport uncertainties, should normally be excluded from the reported uncertainty. If, however, a laboratory anticipates that such contributions will have significant impact on the final uncertainty the customer should be notified according to the general clauses regarding reviews of tenders and contracts.

As the definition of CMC implies, accredited calibration laboratories shall not report a smaller uncertainty of measurement than the uncertainty of the CMC for which the laboratory is accredited.

4 RELATED DOCUMENTATION

ILAC-P14:	Policy for Uncertainty in Calibration
EA-4/02 M:2013:	Evaluation of the Measurement in Calibration
ISO/IEC Guide 98-3:	Uncertainty of measurement – Part 3, Guide to the expression of uncertainty in measurement (GUM:1995)
ISO Guide 35:	Reference materials - General and statistical principles for certification
ISO Guide 99:	International vocabulary of metrology – Basic and general concepts and associated terms (VIM)
ISO 80000-1:	Quantities and units – Part 1: General
JCGM 100:2008:	GUM 1995 with small corrections, Evaluation of measurement data – Guide to the expression of uncertainty in measurement. (available on www.bipm.org)
JCGM 200:2008:	International vocabulary of metrology – Basic and general concepts and associated terms. (available on www.bipm.org)
MSA-L/01:	Field and scope of accreditation of laboratories
MSA-L/12:	Expression of the uncertainty of measurement in calibration (EA-4/02 M:2013)