KENAS
Delivering Trust

KENYA ACCREDITATION SERVICE

PL-38-01

Estimation of Measurement Uncertainties in Calibration Laboratories Policy

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1 Background Information

1.1 Purpose

The purpose of this document is to describe how KENAS will interpret, apply and assess the application of measurement uncertainty within the requirements of ISO/IEC 17025:2017.

1.2 Scope

Applies to laboratories providing quantitative measurement results to customers and are accredited or seeking accreditation under KENAS.

1.3 Legal Basis

KENAS shall implement this policy in accordance with the requirement of ISO/IEC 17025:2017 and for measurement traceability purposes, estimation of measurement uncertainty is key to the implementation of a robust laboratory management system

2 Terms and Definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 17000 and the KENAS Act 2019 and the following apply.

2.1 Acronyms and Abbreviations

CEO	Chief Executive Officer
KENAS	Kenya Accreditation Service

2.2 Definition of Terms

2.2.1 Measurement Uncertainty

Refers to the measurement uncertainty calculation developed to demonstrate how the claimed Calibration and Measurement. Capability (CMC) was derived for the scope of accreditation. It does not refer to the measurement uncertainty calculated as part of the measurement as reported on a calibration certificate.

2.2.2 Significant

Means a contributor whose contribution increases the CMC by five percent (5%) or greater.

3 Policy Statement

3.1 General Provisions

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

3.1.2 Calibration laboratories accredited by the KENAS 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.

3.2 Scopes of Accreditation of Calibration Laboratories

3.2.1 The scope of accreditation of an accredited calibration laboratory shall include the calibration and measurement capability (CMC) expressed in terms of;

a) Measured or reference material;
b) Calibration/measurement method/procedure and/or type of
c) Instrument/material to be calibrated/measured;
d) Measurement range and additional parameters where applicable, e.g.,
e) Frequency of applied voltage;
f) Uncertainty of measurement.

3.2.2 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.

3.2.3 Particular care should be taken when the measurand covers a range of values. This is generally achieved through employing one or more of the following methods for expression of the uncertainty;

a) A single value, which is valid throughout the measurement range.
b) A range. In this case a calibration laboratory should have proper assumption for the interpolation to find the uncertainty at intermediate values.
c) An explicit function of the measurand or a parameter.
d) A matrix where the values of the uncertainty depend on the values of the measurand and additional parameters.
e) 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.

3.2.4 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. Usually the inclusion of the relevant unit gives the necessary explanation.

3.2.5 Calibration laboratories shall provide evidence that they can provide calibrations to customers so that measurement uncertainties equal those covered by the CMC. In the formulation of CMC, laboratories shall take notice of the performance of the "best existing device" which is available for a specific category of calibrations.

3.2.6 A reasonable amount of contribution to uncertainty from repeatability shall be included and contributions due to reproducibility should be included in the CMC uncertainty component, when available. 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.

3.2.7 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.*

3.2.8 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.*

3.3 Uncertainty of Measurement on Calibration Certificates

3.3.1 ISO/IEC 17025 requires calibration laboratories to report, in the calibration certificate, the uncertainty of measurement and/or a statement of compliance with an identified metrological specification or clauses thereof.

3.3.2 Accredited calibration laboratories shall report the measured quantity value and the uncertainty of measurement, in compliance with the requirements in this clause 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. However, the following shall apply;

a) The calibration certificate is not intended to be used in support of the further dissemination of metrological traceability (i.e. to calibrate another device);
b) As specified in ISO/IEC 17025:2017 clause 7.8.6, the laboratory shall determine the uncertainty and take that uncertainty into account when issuing the statement of compliance.
c) The laboratory shall retain documentary evidence of the measured quantity value and the uncertainty of measurement, as specified in ISO/IEC 17025 clauses 7.8.4.1 and 8.4, and shall provide such evidence upon request.

3.3.3 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.*

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

a) 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.

b) 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 [7].*

3.3.5 Contributions to the uncertainty stated on the calibration certificate shall include relevant shortterm 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 in the uncertainty statement. If, however, a laboratory anticipates that such contributions will have significant impact on the uncertainties attributed by the laboratory, the customer should be notified according to the general clauses regarding tenders and reviews of contracts in ISO/IEC 17025.

3.3.6 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 Associated Documents

Ref	Document Identifier	Document Title
1.	GUM	Guide to the expression of uncertainty in measurements
2.	ISO/IEC 17000	Conformity assessments – vocabulary and general principles
3.	ILAC P14	ILAC Policy for uncertainty in Calibration
4.	VIM	International Vocabulary for Metrology

5 Revision/Amendment Records

Date	Ver	Revised By	Reason for Revision
30/04/2022	01	RSQ	Newly developed/formatted document